Goldin discusses key agency issues

NASA Administrator Daniel Goldin visited JPL Sept. 22 and addressed Lab personnel from von Kármán Auditorium. Following is a transcript of his remarks:

I am pleased to be here. I had a wonderful visit yesterday, and I was overwhelmed by the technology I saw. I was also overwhelmed by the capability and the brilliance of the people at the Jet Propulsion Laboratory, so I think it bodes some very, very positive things.

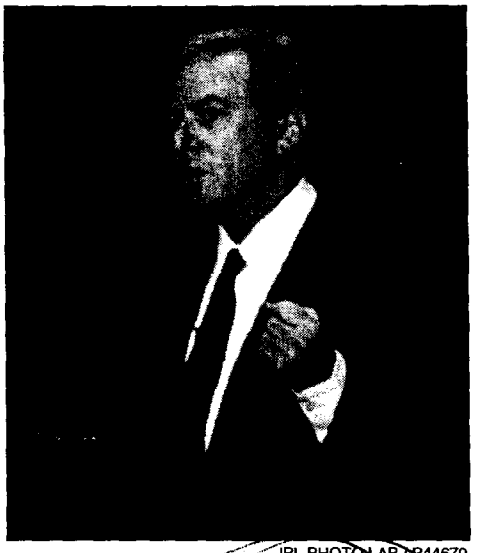
I'd like to introduce the people on this visit with me. Jeff Lawrence heads legislative affairs for NASA; he is the guy who got the bill through Congress. Mel Peterson, the NASA controller, is the fellow who helps us work all of our budget problems and works with the Congress very closely. He is absolutely crucial to what we are doing in Washington.

Let me talk a little bit about the process. I am asking NASA's chief scientist, Dr. France Córdova, to travel to each of the centers to spend two days before I get there. Then I arrive, and I spend two days, opening with an address to all the employees to give a sense of what I think are the issues, problems and directions we ought to go.

I state some basic principles for operation and then talk to the employees to get some feedback. I'm not just interested about the orbits of electrons around protons. I am interested in the issues that are hampering you from doing your job. There are things that I can do, and there are things that [JPL Director Dr.] Ed Stone can do, and there are things that neither of us can do.

There are some external forces that are causing tremendous stress. I am going to identify those stresses, so that you don't fret over them, because if you waste time fretting over external forces over which you have no control, it is a waste of time, a waste of energy, and it will sap your very strength.

Where we can help you with change, we can improve things, and we will do that. So it is very important, when we come around, to talk to us. Now, we don't have a big standing army, it is just Jeff and myself, and Mel will be around looking over your books, so it will be me, Jeff, [my assistant] Pam and Ed Stone.



JPL PHOTO LAB 7R44670

NASA Administrator Daniel Goldin (above) addressed JPL employees from von Kármán Auditorium Sept. 22, discussing key issues affecting the space program and JPL's role in it.

After I make my visit, Jack Dailey—who is in charge of institutions at NASA—will come out, because we will have spoken to a broad cross section of scientists and engineers. Then I would like Jack to talk to the folks in the institutional areas: Finance, administration, contracting, small businesses, what have you. He will obtain feedback in general on what the Laboratory feels, and then we will take all that data, put it together and get back to you with an assessment of what we think. This process will take six months to a year. I want to emphasize it is not a two-day visit.

When I became administrator, I had a thorough plan on how I would manage the agency. The situation with the external forces, which I will talk about in a little while, just overtook me. Instead of doing all the things and having an internal focus like I intended, the last 2 1/2 years in Washington have been spent on myself and Jeff and hundreds of terrific people trying to save the space program.

Now, some people think that the issue is the space station. Let me assure you that the whole NASA space program is on the line. It wasn't a question of a vote on the space station; it is a question of, "Does America want to maintain a civil space program after the perception that, since the Russian competition had collapsed, there was no need for a space program?" That was the issue we worked on.

It is not guaranteed now, but at least we are at some point of quasi-stability, and before the next Congress convenes, we will spend a half year looking internally. Because if the employees don't understand the directions, forces, objectives, goals and vision, we will not be able to perform.

There is a certain level of dysfunctionality that I sense here at the Lab; with all the brilliance that I see, there is an underlying fear and anger that permeates things, causing the Lab to be somewhat dysfunctional. We would like to lance the wound and make sure that these dysfunctionalities won't cause you to go off in the wrong direction.

I also want to say that Ed Stone is outstanding. I am going to say this time and time again, but he has been giving out some very painful medicine, not because he wants to make people suffer, but because he recognizes the forces that are at play. He is not doing it to hurt anyone, but he is doing it because he believes it will make JPL much more effective and assure a future.

If you asked how JPL was doing a year and a half ago—right after the Mars Observer failure—I would have said the chances of survival at JPL were 50/50. So it was not just the space station, and I want to also assure you [that there is] a good news side. Let me assure you that the Washington community, the executive branch and Congress looked to see what Ed was doing; [his actions] lent credibility in terms of what you did, and this had a major impact [on Congress]. I hope you will understand this message as we go through this.

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I will repeat the same thing, because I am so proud of what Ed, the management team and the employees here have done. You turned around Cassini, you restructured it, and that saved it. There could have not been a Cassini, a Mars Pathfinder, a Mars Global Surveyor. All three of them are solidly in the budget. So, the basic message is that NASA and JPL have come through a very trying period, and we now have an opportunity to do incredible things; [we can] change the future of how people on this planet perceive themselves, as well as enhance the knowledge base of humankind.

I want to spend some time talking about these [external] forces, because when I talked to them here yesterday, many people didn't get a sense of it. Sometimes there is a tendency to be isolated from the world, and living in Washington is a little different than living in California.

There is a tendency also among folks who are involved intensely in science and technology to be isolated from the rest of the world, to not follow world events and to think that somehow America will never desert the space program. They think somehow some people in Washington will magically push knobs and levers and leave you alone to do what you do best. You cannot live that way anymore.

Modern communications have changed that. News travels at the speed of light. Unfortunately, the electronic media do not give you in-depth reporting, so perception becomes reality. If you don't read the scholarly journals, the in-depth reporting in the Wall Street Journal, the New York Times and some of the publications from the Counsel of Foreign Affairs, you won't have the sense [of what is really happening], and you will just react to things, and the public does that. So let me walk you through some of the issues I see that provide some context for why change must come, and why we will never go back.

JPL will never look the way it did. You will not build very many spacecraft that look like [Voyager]. You will not have a $3 billion Cassini. You must erase that from your minds. There are those who are concerned that when Cassini gets destaffed in 1997, what will the next big program be? There is none.

It will be a sum total of many small programs that will have to be fought for competitively, and they will have to be the best in the world. That doesn't mean that you are all going to lose your jobs, and JPL will go out of business. It just means that the environment will be different, and [we will have to deal with it].

JPL PHOTO LAB / P44679A

Dr. Peter Siegel (right), group supervisor for the Submillimeter Wave Advanced Technology team, Section 386, shows NASA Administrator Daniel Goldin integrated submicron semiconducting devices to be used in the Earth Observing Satellite's Microwave Limb Sounder.

start a new program, boy, did you get it fast. There was never a question about it. Yes, there was some tension, but it was a different time, and we are never going back unless we have another condition like that.

So, it is very easy for the press, [and other] people to criticize the NASA work force and say they don't have the vision we had back then. We don't have the driving force we had back then—survival. That changed everything. This, I think, is one of the key factors, because all of society is undergoing change.

People try to find culprits. The budget is much less, the conditions are much different, yet there is a sense that the people who work on the space program are less than competent, that they are associated with waste and failure. If you read the press for the last three or four years, [it mentions] the troubled space agency. [The press] took two or three events we have had in the last five years, when we've had some 55–60 successful launches.

We've just had a few failures, and the focus was on the failures because America needed something to grab onto. When there is uncertainty, you look for someone to blame.

I think this caused part of the frustration and anger, because we are now getting a lot more oversight. If there is tion about this, they would show me that. I mean, "what do you want to see?"

So, when all of a sudden Congress is screaming to cut NASA's budget—or perhaps eliminate it—they were not doing it because they disliked NASA or what you've done. You have done brilliant work. The issue that was driving the members of Congress is that the world had changed. The reason for a space program was to beat the Russians—just pick up some of the literature and read it. People said, "No, the Soviet Union has come apart, why do we need it?"

Now the focus of attention was a space station, but let me assure you it was broader than that. [Dr. Stone] probably lives in Washington and cleans his laundry in Los Angeles. He was back in Washington all the time, trying to save your program. So, it was a broad issue. So the Soviet Union coming apart was a big deal.

A second issue is the national debt. The Vietnam War changed America completely, and when it started, our industrial output was enormous, our manufactured goods were sold worldwide, our balance of trade was super high, and then something funny happened. All of a sudden our balance of trade went negative, and instead of driving cars built by General Motors and Ford, ... just take a look at your parking lot today. You can't even buy a VCR manufactured in this country. So, as result, Americans went on a buying spree. A whole psychology changes as a result of the things that happened in Vietnam, and a buildup that came after that. So we had a huge national debt.

A major reason for the national debt—not just the economic reasons—was that we had to have a defense budget that was beyond belief. The United States provided the [world's] nuclear umbrella. When the president of the United States showed up at an international meeting, everybody stood up, because they were under the American nuclear umbrella.

There was just an article after the G7 Summit, and they said that President Clinton did not get the same respect. It wasn't that President Clinton isn't a great president. It was that the nuclear umbrella isn't such a strong issue, and now there is a lot of bump and shove economically. This is disconcerting and people want go back to the good old days, but the good old days of the nuclear umbrella aren't necessarily there.

So, here we have this huge national debt. We had the budget cap. That was the response a year ago—Congress capped that budget. It is locked at $1.5 trillion a year. So, this is an issue. [People] come to me and say, damn, we've got to have that program. [I answer] It's not under my control—there is a cap on the U.S. budget.

There are enormous pressures. We not have the robust stance that it had in the good times. I have a house in Southern California, but I just can't sell it. So, when there is a weak economy, there is a perception about relevance in the space program. Again, we can't just start things unless we can get more relevant to the American people.

The science community is not our customer. NASA headquarters is not your customer. The American people are your customers, and we have done a rotten job in communicating with the American people. We do a terrific job in communicating with the highly educated, but not with the broad population of America. So, is it any wonder that, with all these forces, the NASA budget is having the problems that it does? There is a mood in the country to downsize and change government. The 1992 election sent that message loud and clear, and if you think reinventing government is toy or a joke, come to Washington and see how real it is.

Mike Mott, who is a chief of staff at NASA, went to the White House and met with deputies from all the agencies in all the departments of government. If you think NASA is undergoing tremendous change and stress, you should see what's going on in the other agencies. The federal government is going to be at its smallest level, I think, in two or three decades. So, when Ed Stone is trying to downsize JPL, he is taking presidential directive, and the president is taking direction from the people of the United States. So, there is not any move afoot to cause pain and suffering, but the American people, our customer, want government to be smaller.

We believe in what we are doing, but we will have to earn every last dollar. [If] we want to start a new program, we must be more efficient, or we had better cancel something. By the way, if we just want to stay where we are, we will have to do that in any case because, at the very best, our budget will be constant without correcting for inflation. We will lose about 3 percent a year.

This is a reality, but it is not that you've done a bad job; you've done a brilliant job. You've been part of some of the most important things in history. But now [that] change is coming, how are we going to deal with those changes? I talked about rising entitlement costs, and now there is one other factor, which I call the changing face of Congress.

When Jeff [Lawrence] first took his job—he is a political appointee and works for President Clinton, just like I do—I said Jeff, could you give me a histogram and tell me the distribution of votes we have in the Congress based upon years of tenure. It was very interesting. Those who support the space program had from 12 to 20 or 30 years' tenure in the Congress. their program, they dam well better feel that this program belongs to all Americans, and the program looks just like America.

There is another stress at JPL, and now crazy Goldin is at it again: Why is he forcing small disadvantaged business down our throats? Why do I call for diversity? This is America's program, and by God, every single American who wants to participate in it, and has the skills, will not have gender or culture stop their ability to get in or get promoted.

Now, I don't think there is any malicious segregation, but there is a tendency on the part of my generation to look at people and form some image of what they ought to be. If we re-create the management structure in the image of the structure of 25 years ago, it is a self-fulfilling prophecy—white, middle-aged males.

Don't be angry; participate. It is crucial. When we have a launch, or when those comets slammed into Jupiter, [there were] billions of people watching. Now if billions of people watch only white middle-aged males, it's not right. I'm not saying that we take out only the white middle-aged males and replace them, I am saying that you have to have a diverse work force. [To not do so] is immoral, wrong, and not as effective.

So these are the forces at play. You could get angry about them. Or you can say, by God, the American people have decided what they want out of their space program. We are not going to tell them what *we* want, they are going to tell us what *they* want.

I talked to people about this unifying vision, what the next major mission might be. Someone said, "No, you can't have open discussion, we've got to wait for the right time and then tell the American people what they are going to get." You understand. This is the issue. This is how we have to deal with the space program.

So, what is the impact of all the things we have talked about? First, there were calls in Congress to cancel the space station. Some people thought that if we can get the space station canceled, boy, we will have the money to do the things we want to do. I am sure that nobody at JPL tried to get the space station canceled.

The American public, whether you believe it or not, wants humans in space. There are our customers. They want a balanced space program. They want to see humans in space, but they don't want to spend all the money on it. They are not interested in people making their careers doing wonderful things, exploring issues, understanding the science. They want a program that is relevant to them, and they also want to share the excitement of the human experience.

So if anyone in this room, anyone at JPL, anyone in a science community

who are concerned that when Cassini gets destaffed in 1997, what will the next big program be? There is none.

It will be a sum total of many small programs that will have to be fought for competitively, and they will have to be the best in the world. That doesn't mean that you are all going to lose your jobs, and JPL will go out of business. It just means that the environment will be different, and you will have to deal with it.

Let me deal with the most important [external force]: the collapse of the Soviet Union. The space program was founded in a time of violence. The United States had to make this enormous investment in terribly destructive weapons of war—nuclear-tip missiles. It dominated the thought process of the day.

[When the Russians launched Sputnik,] it devastated America, because we thought we were the technological leaders of the world, and we thought the Russians were in the dark ages. You knew they made a few bombs and a few bullets, but what did they know about space? They launched Yuri Gagarin into space, and the technology, system design and engineering that went into that was a statement: "America really had concern and we were really behind."

So in this period of violence, many forces came together, and Kennedy needed a bold statement, and he looked at space. Some of his advisers didn't want him to go forward with Apollo. But he did.

Apollo was more than just putting a human being on the moon. Apollo was a unifying vision that said America would spend whatever it took to demonstrate to the world that we could lob bigger packages into space, with the implication that we could launch bigger weapons into space.

Through the whole space program—the Mariners that you did here, the Surveyors or the astrophysical things that we did—we demonstrated to the world that America was technically superior, and those countries in the middle would then come into the western bloc, and we could defeat the evil empire.

That's what the space program was about during those great days, and everyone fondly wanted to go back to those days. During the 25th anniversary of Apollo, I kept hearing, "Mr. Goldin, why can't we do what we did in the '60s?" Let me tell you why. We spent 4 1/2 percent of the national budget on space during Apollo. Now we are spending less than 1 percent. That is a big difference.

We were concerned about the very survival of America. We use to have bomb attacks in school. You know, flash attack, hop under the desk to protect yourself from flying objects. So, the nation had a real purpose for the space program; it was part of the national defense. If you wanted to had in the last five years, when we've had some 55–60 successful launches.

We've just had a few failures, and the focus was on the failures because America needed something to grab onto. When there is uncertainty, you look for someone to blame.

I think this caused part of the frustration and anger, because we are now getting a lot more oversight. If there is perception of waste, the American public is going to want to understand, and that is where the oversight comes from. It doesn't come from Ed Stone wimping out and telling the General Accounting Office or the Inspector General they can't come in here. It would be absolutely wrong, if the American public wants to have studies of what we are doing and do all sorts of things to understand; we have to welcome them with open arms. Your leader is not wimping out. He is doing the right thing.

By the way, this change happened with the speed of light. The Berlin Wall came down in 1989, and in '91 Gorbachev dissolved the Soviet Union. In '91, Norm Augustine headed a panel doing a study that started in '90 to see where the future of the space program would go.

In the same year, 1991, Augustine's panel called for a 10-percent increase in the NASA budget, per year, over the next 10 years. That said that the NASA budget would double, close to $30 billion by the end the decade. So, it happened at the speed of light. But, who knew that Gorbachev was going to dissolve the Soviet Union when they were writing the Augustine report, which talked about science being the most important thing we do?

We [were] going to have all these scientific missions, we [were] going to have new starts. There [was] a feeling of euphoria at JPL and NASA. We had the solar exploration initiative, and if we go to Mars, we would have all these precursor missions at JPL that were robotic in nature. We [were] going to have new launch systems; the solar exploration initiative was only a half-trillion dollars.

A half-trillion dollars—now there were some optimists who thought it could only be done for $250 billion, or a quarter of a trillion. It seems funny now, but it wasn't funny in 1991. When President Bush announced it, he was dead serious, because we had to show the world that America could be superior to any other country.

I was appointed administrator on April 1, 1992, and within a few months, I went to Russia and the Ukraine. They took me into the weapons factory, the one I spent the major portion of my career targeting. Now think about that. I walked into the SS18 factory, the most destructive weapon in the world. Here I was walking into the factory, and they showed me the welding machines and if I asked a question about the good old days, but the good old days of the nuclear umbrella aren't necessarily there.

So, here we have this huge national debt. We had the budget cap. That was the response a year ago—Congress capped that budget. It is locked at $1.5 trillion a year. So, this is an issue. [People] come to me and say, damn, we've got to have that program. [I answer] It's not under my control—there is a cap on the U.S. budget.

There are enormous pressures. We have to provide housing for people. There are people starving. The economy is in trouble. These issues must be dealt with. The entitlement programs are growing by leaps and bounds, because the American public wants them. Half of the U.S. budget is entitlements, $750 billion a year. A quarter of a billion dollars goes to paying off the debt; now we are at a trillion dollars a year. So, five-sixths of the federal budget is really capped, with some [items], like entitlements, growing. This is why there is the health-care debate.

So with the cap at $1.5 trillion a year, you deal with the domestic discretionary spending. Guess where NASA is? In domestic discretionary spending, we have veterans who lost their limbs in war. Could you turn them away? That budget goes up at 8 percent a year. When you really get down to it, maybe about a $100 billion a year is what Congress operates on, and tries to deal with all these pressures. So, it is not that they are against NASA, or what we are doing. It's saying one message: the NASA budget has to come down.

When I took over as administrator, we had this momentum model for the budget. I kept telling people we can't go on like this, and they thought I was a bad guy. I love everything in space. I love everything I see, but the reality is these issues playing here. So, if someone at JPL wants to start a Pluto Fast Flyby, where does the money come from? We've got to cancel something. The budget at NASA is going to come down, for the next five to 10 years, no matter who is in the White House.

We have a weak economy, [and] it is hard for America. It's a lot better today than it was two years ago. But it still does

there is one other factor, which I call the changing face of Congress.

When Jeff [Lawrence] first took his job—he is a political appointee and works for President Clinton, just like I do—I said Jeff, could you give me a histogram and tell me the distribution of votes we have in the Congress based upon years of tenure. It was very interesting. Those who support the space program had from 12 to 20 or 30 years' tenure in the Congress. They were part of the Kennedy buildup. They understood more than just the competition aspect. They were an integral part of the program, they shared our successes and cried with us when we had our failures, but they understood. The members who were in Congress between six and 12 years were lukewarm for the program, and the members between zero and six years generally voted against the program.

Now it gets worse. In the election of '92, more than 100 members of the House of Representatives turned over. The projection for '94 is that another 100 people are going to turn over. These are fresh new faces, people who are coming in because the incumbents lost, because America wants change, smaller government, a government more responsive and more relevant, that is going to deal with the issues of the country. They are not going to deal with tradition. They want change. That's what America wants.

A number of women has been elected to Congress, which I think is beautiful and wonderful. The size of the black caucus is increasing. The size of the Hispanic caucus is increasing. Congress is more representative of what America looks like. [But] many women and many minorities don't feel the space program has been responsive to all of America.

The image of the space program is mission control at JPL or in Houston. Generally, what you see are white males with white short sleeve shirts, and—this was a few decades ago—crew cuts. I am not saying that being a white male is bad, but what I am saying is if America owns this program and they are our customer, the National Academy of Sciences is not our customer. If this is humans in space, but they don't want to spend all the money on it. They are not interested in people making their careers doing wonderful things, exploring issues, understanding the science. They want a program that is relevant to them, and they also want to share the excitement of the human experience.

So if anyone in this room, anyone at JPL, anyone in a science community believes that by canceling the space station they will get a better set of situations here, they are wrong. Again, that is immoral. By what right should you protect your jobs when the program belongs to the American public, and we have to be responsive to them?

They don't owe you anything. They just want to get things that can inspire them. To have their children want to enjoy math and science. They want to understand creation in the broader sense, the crossover between cosmology and theology. They want to understand how the solar system formed. This is the nourishment of life, what is important. They want to share it through the human experience.

People think that when you cancel one thing to protect jobs, it will backfire and will be a disaster. So what we have strived to do is have a more balanced program, because the human space-flight account took up 50 percent. We now have it down to about 38 percent, and I hope that we can even get it lower. We have increased the science portion, because, I think, again, that is what the American people wanted.

In town hall meetings, that is what they told us. There was a call for cancellation, and then it wasn't helped very much because we had the Hubble problem. We had the Challenger [disaster] and [stories about] the troubled space agency. One evening at a dinner party in my house, I got a call that we had lost Mars Observer. So, I said let's do what we have to do, let's call in the press and be very open with them and say that we have had a failure.

Within eight hours, we lost a weather satellite. Then the Defense Department launched a classified spacecraft for a billion and a half that went into the drink. Do you know what the first headline was? "NASA loses another satellite."

You see, the public identifies space with NASA. We are an unbelievable inspiration to them, so they give us credit for or they beat us up for anything that happens in space. But it is wonderful, and I am thrilled that that happened, because it indicates that America wants a space program. But those failures did not help our condition. When you have a failure, the most important thing you say is, hey, we had a failure. You don't make excuses: "It was headquarters' fault."

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Congress is very serious about us doing what we say we are going to do, and we can't constantly slip launch dates and costs, and change what we said we would do. That is probably more important than anything I've said.

—Daniel Goldin
NASA administrator

Goldin

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I had a discussion last night with a woman who spoke passionately, asking "Why are you ruining the reputation of this Lab?" I said, the Lab is accountable and responsible for Mars Observer; it failed. Stand up, and say it failed. If there was something wrong, you should have called it out and said we shouldn't have done it. If we at headquarters or anyone else forces a contract down your throat that's stupid, just say no. I'm serious about that. You better not take it, and then when a problem occurs, say, "I have an excuse." No excuses are accepted. This is the subject of accountability and responsibility.

We got a wake-up call a year ago. The space program passed by one vote. Notice I didn't say the space station. The space program passed by one vote. There were calls to cancel Cassini, to not start Mars Global Surveyor. But we communicated with the American people and Congress, and I am happy to say that in 1995 we won by two to one in the House and Senate. I hope today that they will actually get the bill that the Senate ratified. It is a very healthy bill.

What are the solutions? We have two choices. Everyone [here] votes. You vote with what you do around the water cooler. You vote with what you say to your fellow employees, you vote with how you feel. You could say, "Hell no, I won't go; I want to hold on to the old program." Or you could choose a path of change, and roll with the punches.

When auditors come in, you can say, "God bless you, we need you, we love you, we will give you everything we've got." I say that half-seriously and half in jest. Because if you tell auditors they are not welcome, how do you think they are going to feel? Do they think you are trying to hide something? I think so. They are doing their jobs. They have been asked by the executive branch and by Congress to review what you are doing.

Let us say, across NASA—and I include myself when I say it—our record of overruns is beyond belief. A record of not delivering on our promises is very open. There is a sense that all we have to do is get it working and launch and all is forgiven, hoping that it will never occur again.

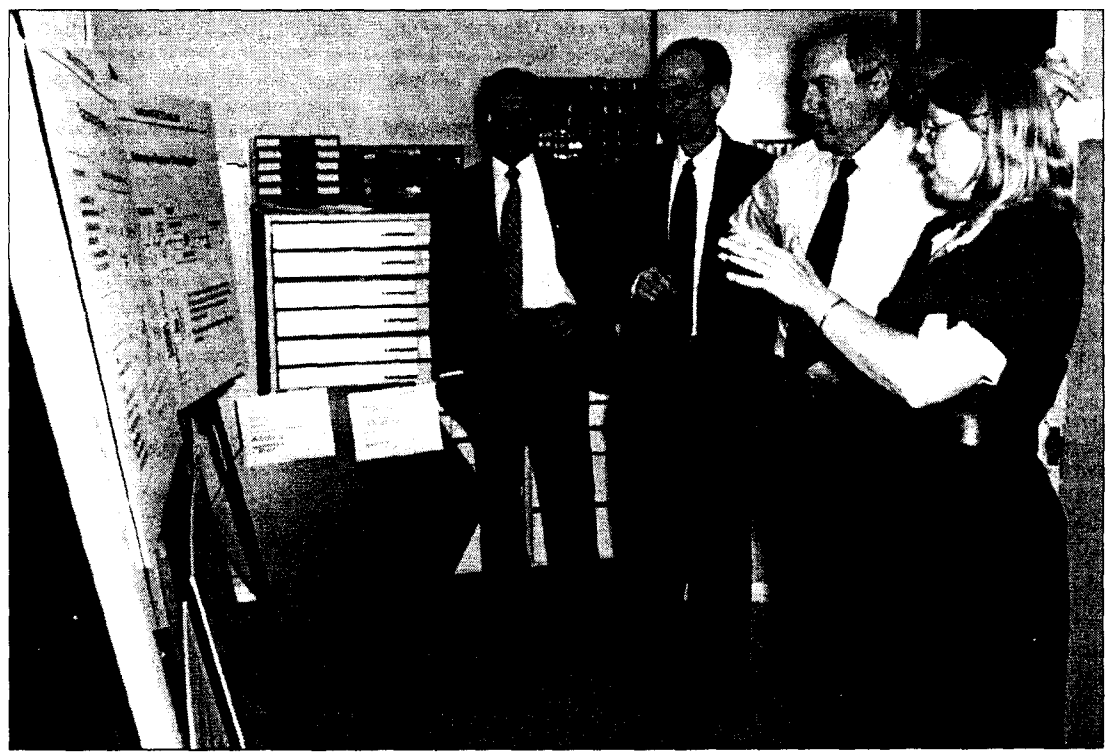
The American public wants a lot more from NASA. So we will choose a path of change, learn to live with the declining budget and make the most of it. We must rebalance the program between technology and science, big and small, humans and robots. We will make room for new starts by being more efficient, drastically changing how we operate, canceling sick what you have done to change. Even though there is some concern, you have sent the right signals. You wouldn't have Cassini, Mars Pathfinder and Mars Global Surveyor if you didn't change. So you were the ones who really did it. Ed Stone was the spokesperson, but you actually did it.

[I would like to talk about] the generic vision for NASA, a new operating mode, seven basic operating principles, people issues, and how JPL fits in.

First, let me say, if we perform and execute with the talent pool we have, I believe we have an unbelievably bright and clean on overruns. But everyone says "hey, I did my job, I'm safe. I spent $60,000 on this report. It is all documented." [But] it is worth the powder to blow it to hell.

Now, this does not have anything to do with shuttle safety or quality of a Voyager spacecraft. This is about denuding forests. So now this operational and institutional stuff has to go. I submit that you could eliminate 1,000 jobs here and convert those jobs into going to Pluto and the sun, and into building interferometers that might actually take a picture of a planet around a star. Now, wouldn't that be in the development stage and in the experimental stage. That's why we want JPL. We don't want a production facility here. We want your brilliant minds to go to the next frontier. Peer review dominates. So, let us look at the criteria for the new set of peer reviews. By the way, if you have better ideas, we need the feedback.

First, relevance, not survival, dominates. Will it benefit America? Will it inspire young people? Will it provide a new level of knowledge to humankind? Will it provide technologies to spur new industries? Will it involve America?



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Dr. Margaret Frerking (right), assistant manager, Coherent Instruments and Large Optical Systems Section 383, shows NASA Administrator Daniel Goldin what she termed "technology development that pushes radio techniques to extremely high-frequencies in submillimeter wavelengths," during Goldin's Sept. 21 visit to JPL's Submillimeter Receiver Lab. Dr. Charles Elachi (left), director of the Space and Earth Science Programs Directorate, and JPL Director Dr. Edward Stone look on. They discussed superconducting and semiconducting devices whose applications include astrophysics and Earth remote sensing.

promising future, but one with no security, because we will have to earn it. We are on a path toward consensus, and 10 years from now NASA will look very different.

First, we are much too focused on operational and institutional issues. We have much too large a fraction of our budget dedicated to that. Wes Huntress' budget—which is Space Science, and that is where you live—has about one-third of its budget in operation. What a waste.

more fun than being angry and frustrated every night?

This is the issue, and this has nothing to do with your brilliance or dedication. This has to do with the fact that no one is willing to question the requirements under which we operate. You must have some courage—remember "question authority"?—you've got to do it. And if you are afraid, you don't belong here.

I am being very harsh and severe [illegible] about the future of

These are the questions of relevance.

Second, cooperation, not just competition. The world has changed. The weapons builder walked into the former enemy's weapons labs. So, we are going to have to work with other countries, and I think JPL is right on target. You are talking to the Russians about a program called Mars Together.

Why should we have common infrastructure? If we have to put up the same things as the Russians for infrastructure, we have less money for designing space-

took 400 pounds. So, less is more.

Diversity in people, places and ideas is something that I will not yield on. I believe you will not yield on it either. When your program comes up for peer review, if it has not touched a cross section of America, it will be marked down. Companies are told [this] when they bid on programs. I worked with Wes Huntress to make sure the Discovery proposal called for diversity.

Are you involving a cross section of America in the program? Not people who aren't qualified, but people who have the right degrees and the right knowledge. But we have a tendency to say, "show me your experience and then I'll see if you get the job." Now, how in the world will you get the job if you don't have all the experience, but you have the human potential? You have a demonstrated ability to do things, maybe not in those categories. It is crucial—I can't emphasize this point strongly enough—that I want you to understand the most magnificent scientific project may not make it unless you are cognizant of this. There are some outstanding minority[-owned] businesses out there. I've worked with them.

When I was at TRW I was asked, "How can you involve the small disadvantaged business and build quality hardware?" I said that they have built quality hardware, and all we have to do is teach them NASA soldering and some of the flight procedures. There was a revolution in manufacturing, and [it was] said that they were going to destroy programs. This company delivered on time, on budget, with equal or better quality. Not if they were just getting a free reign, and if they don't perform, you can't contract.

But you've got to change the way you look at people and things. We cannot go on this way in America in terms of gender and culture. There are people in North Dakota who have a wonderful aerospace institute there, but they are locked out of the space program. Most of the activity in the space program takes place in California, Alabama, Florida and Texas. We have to open up our minds to new ideas and not lock them out because they are not part of the "old boys' network."

Think about it. I'm know I am coming on real heavy, but most of us are comfortable with those we know, and don't give those we don't know credibility for having a capability to do things. The U.S. Congress doesn't look lightly on this "old boys' network," and we've got to eliminate it from our thinking.

Outreach. In our town hall meetings and talks with members of Congress, I am getting universal feedback that NASA is not communicating. How many people wrote for My Weekly Reader? I did. How many people wrote an editorial for their

hoping that it will never occur again.

The American public wants a lot more from NASA. So we will choose a path of change, learn to live with the declining budget and make the most of it. We must rebalance the program between technology and science, big and small, humans and robots. We will make room for new starts by being more efficient, drastically changing how we operate, canceling sick chickens and prioritizing. Darwin is going to reign supreme at the NASA of the future; survival of the fittest is what it is going to take.

I believe it will make the program stronger. No longer will we allow mediocrity. Now, I don't think mediocrity comes from the people. We in management have given you outdated systems. You don't fail, we fail you. The systems we had in place were designed for the period when we were going to beat the Russians, and getting things launched—not cost—was most important. But in the new operating room, this is no longer acceptable.

Again, I understand your frustration. But don't take it as a sign that you have failed, especially at JPL, where you have some of the most brilliant people in the world. Your capability is second to none. But again, when the country is in a negative mood, the employees generally get criticized and you take it personally. I am the administrator, and I am telling you you are outstanding. I see what you have done. It is wonderful.

I believe that we are on the right path, that the changes here have happened so fast that no one even saw them coming. In November 1992 the change occurred when Americans went to the polls. The president is in the process of making this change happen. So, we have the best support in decades from the White House. The president is engaged. He spends an enormous amount of time on this program. The vice president is engaged. I don't know how many phone calls he has made. The president and vice president have invited the leaders of Congress to the White House. They involve the whole U.S. government. We have a priority that is way at the top.

During the Apollo celebration, I was in the Oval Office with the president and three great Americans—Michael Collins, Buzz Aldrin and Neil Armstrong. The president couldn't stop talking about how proud he was of the tremendous support for the space program and the vote that we had. The Congress gave us a two to one margin; the people at the Office of Management and Budget are engaged. They know what you are doing. There is tremendous excitement.

I believe the American people's perception is changing. We are no longer called "the troubled space agency" because of

because we will have to earn it. We are on a path toward consensus, and 10 years from now NASA will look very different.

First, we are much too focused on operational and institutional issues. We have much too large a fraction of our budget dedicated to that. Wes Huntress' budget—which is Space Science, and that is where you live—has about one-third of its budget in operation. What a waste.

Why should we have people sitting at consoles in 1994, when we have the wonderful technology I saw [here on Lab] just yesterday? You have the technology to almost eliminate these operational jobs. I would like to see you launch a spacecraft that is hands-off. Why do we need people even talking to a spacecraft when it is on a 10-year voyage?

I took a look at some of these frequency standards. It boggles the mind. In the Microdevices Laboratory, I saw a camera that does all the mission planning for you. You don't need a team of mission planners. You can look at the planet and pick out all the key features automatically—no people involved. So, why not take that money and spend it on development?

In the '60s, NASA was a development agency, doing bold, exciting technology, breaking technology barriers. Now take a look at our work force; we have a whole bunch of people doing things that could put you to sleep. I am not saying that everyone at the Lab is doing operations or institutions, but let me give you some evidence.

The Mars Global Surveyor was supposed to be faster, better and cheaper. *[Drops stack of operations manuals on table.]* Gravity works. Everyone thought they were doing the right thing. This is not the way to do things. There is no excuse for all this paper in that package.

[Another] package is the famous JPL procurement forms manual. Now, do you want to spend your remaining days in the space program dealing with garbage like this? Who has the courage to say that this is unnecessary? This is not what we are about. We are about leaving Earth. We are not about paper.

There is a group down in the South who had 200 people trying to reduce touch labor. Guess how many people in touch labor there were? Two-hundred. I want to cry. This is not what we are about. Yet, when I ask for the budget to be cut, I'm told safety will be impacted on the space shuttle and destroy liability on these other flights. I think that is a bunch of crap.

Let me give you another one. This is not from JPL, but it could be. Here we have a quarterly financial report, Form 533. There are more work codes in this than the number of people working on the job. Nobody read this report. Then the Congress ... is investigating NASA because the contractors are not coming

every night.

This is the issue, and this has nothing to do with your brilliance or dedication. This has to do with the fact that no one is willing to question the requirements under which we operate. You must have some courage—remember "question authority"?—you've got to do it. And if you are afraid, you don't belong here.

I am being very harsh and severe because I am worried about the future of the space program. And JPL is not about this stuff. We are going to have a new technology program; it's called the New Millennium spacecraft. Ed Stone and I had dinner two months ago, and I said to Ed, "Why isn't JPL the best in the world in quantitative science and large astrophysics?" We went through it and we are not investing

We have a Catch-22. You build spacecraft and the program manager says, "the program is so big and so long." You go to the program manager with a new widget, and the program manager says, "I can't fly that because it didn't get tested in space." You say, "How will it be tested in space if you don't fly it?"

We will break out of that, because we will make an investment. Now I am going way out on a limb. This program isn't approved. But I am absolutely committed to carrying it forward, and if we do it by the year 2000, we can launch 10 to 15 spacecraft a year. Not a decade. A year. Won't that change the face of the space program?

And another thing is that we need more experimental craft. When we [previously] built [spacecraft] it cost a lot of money, because we had to check it out on the ground, we had to do a lot of analysis. Now, what if we built some experimental craft that test technology, and launch these things all the time? That is what you are going to do. Talk to the folks over in the Microdevices Laboratory. They have an unbelievable concept. So we will get away from this constraining Catch-22, and we will have experimental programs, not just for spacecraft, but for launch vehicles.

I made a commitment to Ed Stone. If we want to have 10 to 15 launches a year, you can't pay $20 million to $60 million a launch. We are going to try to get you a launch vehicle on the order of $5 million to $10 million.

How are we going to do it? In testifying before the Congress, the new launch vehicle is the highest priority. The next highest priority is a New Millennium spacecraft. So we are going to cancel something. Peer review and Darwin are going to have reign supreme.

[There will be] changes in the way the agency will look. We won't have vast control centers with hundreds of people doing these things. We will have people

Second, cooperation, not just competition. The world has changed. The weapons builder walked into the former enemy's weapons labs. So, we are going to have to work with other countries, and I think JPL is right on target. You are talking to the Russians about a program called Mars Together.

Why should we have common infrastructure? If we have to put up the same things as the Russians for infrastructure, we have less money for designing spacecraft. We will also have to work closer with other government agencies and JPL. We are going to have to help you.

There were some complaints yesterday that NASA is causing you to have an at-arms-length relationship with industry. We need you to get closer to industry. You could spur economic development in this nation beyond belief, if we empowered you to do that, and we will have to figure out ways of doing that.

Revolution, not just evolution. Relevance has been overtaken by technology, so we are going to have revolutionary new technology, and I will give you an example. After Ed and I had dinner a few months ago, within three weeks he walked into my office and said "Here is the replacement to the MESUR mission." Keep in mind that two years ago, JPL said the MESUR mission would cost $2 million, and we would have landers, retrolanding on the planet or using parachutes.

He showed me a one-pound spacecraft with the payload the size of my fist. Something that might be built for hundreds of thousands, and you drop them out of the [Mars Global] Surveyor spacecraft all over the planet. You could make meteorological measurements, and yesterday, they said they could even make seismological measurements. So you could literally reduce the price of that mission with technology as an enabler, and really get the data that we wanted.

So, MESUR would have provided a lot of security and a lot of jobs, but the new approach is going to open up science on Mars and on other planets that have an atmosphere. Technology is an enabler, it is crucial, but the problem was that we at NASA did not make an adequate technology investment at JPL, and with Ed's leadership we are going to try and change that. We are going to fight that battle this year.

Less is more. Remember, I said the budget is coming down. Just take a look at what you are doing on Pathfinder. That is 1/20th the cost of Viking. You are doing a lot of good science. It is a very valuable mission. The shuttle just landed. The people at NASA's Johnson Space Center built this thing called Safer, a jet pack that hooks onto the life support system. For $7 million. The prior jet pack was $100 million. This does the job in 90 pounds [where before] it

ing a capability to do things. The U.S. Congress doesn't look lightly on this "old boys' network," and we've got to eliminate it from our thinking.

Outreach. In our town hall meetings and talks with members of Congress, I am getting universal feedback that NASA is not communicating. How many people wrote for My Weekly Reader? I did. How many people wrote an editorial for their hometown newspaper? To explain to them the beauty of what you are doing, to share your experience. But how many wrote in scientific journals? I bet almost every hand could go up.

This is not the job of the administrator or the public affairs office. I told public affairs "not a nickel for propaganda from NASA." The outreach comes from everyone in this room, and if you don't do it, it is not going to happen. It is like water on the parched desert when you do these things. You'll improve the quality of people's lives by talking about the beauty of what you do.

My final principle is do what you say you promise to do. Don't rush into a job, don't have a job where you haven't worked out the requirements in advance. Don't pick a budget or a funding profile that you don't understand. Say "I'm not ready; if you want to force it down my throat, go some other place." The new rule is that you've got to do what you say you are going do.

Clearly, if you are going through a scientific frontier and have a problem, you probably can't anticipate that. Of course we are going to deal with it. But I am not talking about that; I am talking about broken promises. I am talking about overruns due to mismanagement—not by people but by systems.

The Congress is very serious about us doing what we say we are going to do, and we can't constantly slip launch dates and costs, and change what we said we would do. That is probably more important that anything I've said.

I spoke to your Cassini program manager. There is a little problem here, because I talk about taking risks, but let me tell you, we cannot afford to have Cassini fail. Now, I would love to tell you that there is lots of room for margin. I also want you to know when the debate started, I wanted to cancel Cassini, because I thought it was much too big, much too complicated, it was putting all our eggs in one basket. If the launch vehicle failed—and we are [using a] relatively new launch vehicle—all the beauty of the mission would go away.

If the payload failed, we would not have the hope of the country, and $3 billion is a lot of money. So, everyone wanted to do it, then there was an outcry; the scientific community wants it. Our inter-

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national partner said to the United States, "you've got to do what you say you are going to do." That is why we decided we would go for it. Because when America gives its word, we've got to live by it.

I am expecting JPL, which desperately wanted this program, to perform, and I am holding you accountable for the launch vehicle and the payload—no excuses. You had better understand the launch vehicle now. You had an opportunity to go on the shuttle, but you selected the Titan IV. So you can't go and say "Hey, everything is OK, [but] the Titan IV failed."

I am setting the rules of the game right up front. If you have to understand every resistor in every European payload, and have [the Europeans] understand every resistor on our payloads, go ahead and do it, but do it now. Don't set yourself up for an excuse.

Now, I am being very tough. But I want to tell you, I believe I understand the sense of the U. S. Congress and the American people. All you have to do is listen to a few hearings that I was testifying in, and see what was dished out in terms of the intensity of those hearings. I put my hand on the Bible and I said we are going to launch Cassini, but you [at JPL] are accountable. The program manager here is accountable and responsible. Ed Stone is accountable and responsible.

I am saying this up front so there is no question later on. Not because I want a failure, but because I would like you to put in the intensity and do what is right now.

I am [also] concerned about the Mars Pathfinder. Some young man said yesterday "Mr. Goldin, you can't expect us to guarantee success; it is [being built with] class-C parts." Hey, they are spending $171 million, plus $60 million for a launch. [That is] a quarter of a billion dollars. Wake up and smell the coffee.

We don't have 10, 15 launches a year. We have already failed on Mars; now, I wish it was different, but we are going to live under the eye of the microscope, and I say we, because I join with you. We are going to have to produce on those three programs.

So, I want you to understand this concept of risk. Take the time now and don't set yourself up to make excuses later. Do what you need to do to make a parachute system work. I understand it is a few months behind schedule. Don't take shortcuts. If you've got a problem, say it, and if this than JPL. I am not talking about 2030 and 2040; these things could happen in 10, 15 years. This is within your grasp if you decide, "This is not going to dominate my thought process, but I am going to convert that money into doing the things" I just stated.

You are flying circuit densities that are decades old on every spacecraft you have now, and on Cassini. Take a look at what's available now, look at the software. You are flying aluminum; why not injection-molded bodies? How about expert systems in these new cameras? These are the things you've got to do.

I believe JPL is going to be the catalyst that changes the whole NASA space program. The whole world's space program. The only way you will do it is to decide you are going to get over anger and frustration and fear, and you are going to say what a privilege it is to work here. Yes, the standard of living will go down. But the standard of living of America is going down.

The standard of living can't go up at JPL while it is coming down in America, and I know that there has been a salary freeze, that we have had compression in the management ranks, that there are restrictions on travel. But what a privilege to be able to work on these things. I get goose bumps just thinking about it. You can change the way the human species looks at itself, and you can do it within your lifetime. This is what I see as a vision of what we can do.

Let me say further that we have four things to do before we can send humans into space again on a major mission. We have to figure how they can live and work safely in space. There are some unbelievable problems to overcome. What happens when cosmic particles rip apart the genetic code? How can we responsibly send anyone out of the protection of the Earth's magnetic field into space before we do this? How do we screen people so they won't develop cancer or heart disease on the trip?

We are going to be on the cutting edge of genetic engineering. Now, we have to be careful not to violate the rules of ethics. But we have some incredible things, including chemical and genetic surgery, because you can't afford to take an operating room on a spacecraft. This is what the space station is about. It's not about jobs. It's not about maintaining stability. Also, the space station is a cultural testbed. We are going to learn with Russia, and not point weapons at them.

Third, we've got to do these missions not for a half trillion, but for $25 billion, and not in 30 years, but in eight years. The technology, to a large degree, could step back from brutal treatment of people. We've got to communicate. I see this as a parameter here at JPL.

So how do you fit in? I would like you to be the center of excellence in the world in remote sensing. Now, I define remote sensing as the planet Earth, the bodies in our solar system, and planets around stars. I would like you to be best in the world in the robotic exploration of planetary bodies. This is my sense, this is my hope of where the mission for JPL fits in.

If you can't be best in the subcategories, drop out. Benchmark yourself and see how you are, relative to other people in the world. If you are not number one, say "Here is my plan for being number one." If after three or four years you can't get to number one, drop it. So, let's not try to duplicate things and not be best in the world.

Second, do what you said you are going to do, and hesitate to make a commitment until you understand. Let me give you an example.

I spoke at a management executive program, and a young man said he was working on his thesis. He was going to take 340 kilograms of payload to 27 kilometers for 50 hours, and I think he is talking about $10 million for doing it. So they work the program out, 340 kilograms, then a scientist walks in and says "I want 400 kilograms. I need to do these things." The young man said, "No. You are getting 340 kilograms, that is what we agreed to. We had a contract. I am not budging one ounce." So, after you sign a contract, unless there is some earth-shattering need, just say no. Otherwise we will be in this terrible cycle we have been in.

So do what you said you are going to do: Cassini, Mars Pathfinder, Mars Global Surveyor, New Millennium Spacecraft. We are going to cancel other things so we can get this started. Live up to the promise. I know you can. But have enough guts to say, "It is a privilege to be working on this. I am not going to be concerned about second-order effects and I am not going to let it make me dysfunctional."

Three, we are initiating a zero-based study. You don't know where you are going unless you know where you are. Wayne Littles is the chief engineer from NASA heading it up and Ed Stone is in charge for JPL. We want to review all our functions and programs, and understand what each person is doing and why. Then we are going to request the requirements so we can avoid having things like this.

Don't look upon this as another exercise. This is for real, big time. We need and optical communications. It is not his fault, but the management in the research area didn't help him understand what the challenge was, and how optical communications fits into the picture.

You could work on the most wonderful technology with passion, but if you don't know how it relates to the big picture, are you working on the right thing?

You need to have this contract with your boss [stating] the inputs to you, the outputs, how do you relate and what are the things that you are going to accomplish during the year. Make it very clear. When you have fuzzy contracts, there is room for frustration, anger, and fear, and I hope I am not directing you, Ed; this is a request. You might want to think about it.

I went a long time, but I had a lot to say, and I don't have a chance to talk to you all the time, but I would like to close by saying I am deeply committed to the space program.

On July 20, 1969, when Apollo landed, I was at the airport. I was going to Harvard to take a course that summer and I missed my plane because I couldn't leave the TV set. Then when Neil Armstrong landed and stepped on the moon, I cried and hugged people I didn't even know. I would like to think that 10 or 15 years from now I could see a base on an asteroid and know that I had part of it and shared it with you. Thank you very much.

I am not going to take questions, but when we come around I'll be meeting with a cross section of people. I would be very happy to talk about these issues. I clearly feel passionately about them, but I don't have infinite wisdom.

The wisdom is in this room and at this Laboratory. But I hope that you have some understanding of the environment we are all working in, and that it is essential to work together. ❑

New life insurance coverage available for JPL employees

This month, JPL employees will be sent letters detailing the upcoming switch of voluntary life insurance—from "Tri-Term," the plan offered by Northwestern National Life Insurance—to "Group Universal Life," the program offered by Connecticut General Life Insurance Company.

During the open enrollment period of Oct. 10 to Nov. 1, employees already enrolled in the old plan have three options. They can 1) stay with the old plan and make quarterly or annual payments directly to Northwestern National; 2) keep their old plan and add the new plan; or 3) switch to Connecticut General and drop the old plan.

In addition, during the open enrollment period, employees not currently enrolled in the voluntary life insurance plan will be able to enroll themselves, their spouses and their children in the new group universal life plan under simplified guidelines.

According to Caltech Manager of Benefits Kathy Montes, the new plan has certain advantages. "Connecticut General has a more favorable rate structure and offers an optional cash accumulation account, where employees can make contributions to a savings account that will accumulate on a tax-advantaged basis."

Details of the new plan and a personal statement of each employee's life insurance benefits and the coverage available under the new plan will be sent to employees' homes during the early part of October.

Meetings have been scheduled in von Kármán Auditorium to explain the changes in the insurance plan on Oct. 11 at 2:30 and 3:30 p.m.; Oct. 13 at 8 and 9 a.m.; and Oct. 19 at 8 and 9 a.m.

Also, a group universal life program representative will be available in the 167 cafeteria to answer questions, starting at 8 a.m. on Oct. 12, 14, 27 and 28. ❑

Safety incentive program helps

So, I want you to understand this concept of risk. Take the time now and don't set yourself up to make excuses later. Do what you need to do to make a parachute system work. I understand it is a few months behind schedule. Don't take shortcuts. If you've got a problem, say it, and if you overrun more than 15 percent, we cancel it. I want you to be sure that you understand the rules. This is how Darwin works.

We are going to explore the solar system in the universe as we have never explored it. We are going to have flyby missions, orbiters, landers and sample returns.

I was just at the moon rock [display] in Houston. How much room do you have [on spacecraft] for rocks from asteroids and comets, and how much room do you have for rocks from Titan, and some of the other moons from the other planets? This is what you are about. You are not about this. *[Points to stack of procurement manuals.]*

By the year 2000, you ought to be launching these missions. I believe you could have a sample back here by 2003 or 2004. Maybe it won't be hundreds of pounds, maybe it will be 100 grams. Imagine what you could learn. You could do it.

Now, if you want to see the face of the future, go over to the Microdevices Laboratory. They have a spacecraft on a chip. It is literally the size of a silver dollar, and you just drop a whole bunch of these things through the atmosphere, when you could make magnetic measurements. We are going to do whatever it takes to get you the resources to do that.

I also believe that astronomy and astrophysics are good, but not outstanding. There is no reason that we shouldn't be able to image with real resolution. They showed me something yesterday and said "Dan, we could build this interferometer, and we could get one pixel and image a planet. Before that we could infer that planets exist around stars by looking at the stars' orbit. I said "No, I want 25 kilometers' resolution." But could you imagine, if we did it.

Now let me tell you what you've got here, if you don't know about it. You are among the world's leaders in optics. ... We could make cheap reflectors, ultra lightweight, ultra low cost, and it's right within our fingertips. Maybe what we have to do, Ed, is make this part of the New Millennium Spacecraft and open the definition of planetary and say that means to do real relative planetology.

Again, I know of no better place in the world that has the capabilities to do bility. Also, the space station is a cultural testbed. We are going to learn with Russia, and not point weapons at them.

Third, we've got to do these missions not for a half trillion, but for $25 billion, and not in 30 years, but in eight years. The technology, to a large degree, could come from here. The most successful exploration missions have been living off the land. You are working on a concept here to convert the Martian atmosphere into breathing gases and fuel to return to Earth. How about in 2002 we [have] a breathing gas station, a fuel station and a robotic station on Mars to see if it works there?

You can do it for a half billion, but do it for $50 million and $100 million. Why not? You could allow the human species to leave earth orbit. Everyone is tired of the shuttle going up and down. It is boring. Who wants to spend $4 billion a year to go up and down? We've got to get out of Earth orbit.

And finally, the fourth condition is precursor missions. One, we could explore the asteroids and the comets. We could put a space station on an asteroid. Everyone is interested because of what [may] happen if one bumps into the Earth. Look what happened with [Shoemaker-Levy at] Jupiter.

So we have to have an exploration mission robotically to the asteroids to find out their composition. Do they have water content? Could we convert the water into fuels and breathing gases? Are there hydrocarbons or minerals there? What should we do with them?

Another possibility is to go back to the moon and do a lot of scientific research, and perhaps some commercial activity.

We could go to Mars, to find if life exists. You are taking the first step with Pathfinder. I made a speech to the American Geophysical Union and said "Let's have a national debate on this subject. Let's ask the American public what is it they want instead of telling them what they are going to get." I encourage you to participate.

Let me just summarize here that people are the most important asset we have. As we undergo change, management at JPL and NASA can't have anger between each other. As I come around today, when Jack Dailey and [NASA chief engineer] Wayne Littles come, talk to us about the things that are causing these stresses.

We've got to treat people with dignity. Just because you are a manager doesn't entitle you to brutalize anybody. Everybody has quality, and we've got to charge for JPL. We want to review all our functions and programs, and understand what each person is doing and why. Then we are going to request the requirements so we can avoid having things like this.

Don't look upon this as another exercise. This is for real, big time. We need you to do it, so we could have the resources to do what I just talked about. This is $60,000 every three months for one NASA program, a quarter of a million a year. It is 10 percent of your discretionary budget; Ed Stone, 8 percent. Think of what you could do with that. On the plane, I read your annual report on the discretionary programs—it is wonderful.

The things you want to look for are management and employee to manager ratio. At JPL you are five employees per manager. We want 11-to-1. It has been mandated by the president of the United States. NASA is going to get to 11-to-1.

Now, I understand that everyone can't be a manager. It isn't a statement that the people who are not managers are not valuable. You can take your brilliance and apply it in dual ladder. We need a dual ladder. One of the things we have to talk to JPL about is that management is going to [be compressed], which is healthy.

I love it, I support the president. He is asking for the right thing that dual ladder allows. Feedback allows promotions, and it allows people to do what they do best—technical things. So I view it as freeing up more brains to do the job we have. I know that it is going to be frustrating. But the key to it is that those in management cannot view other people without looking at their true value. You send signals not by what you say but by how you act.

You have the best people in the world and it is essential you be treated that way. If you are not being treated right, don't put up with it.

My next to last point is, we've got to remove the anger and fear and be so proud of what we are doing, and we've got to work together. You have the right leader, you have the right facilities, you are in the right place. It's crucial.

And finally, I am going to ask each of you to make a contract with your boss. On one sheet of paper, write down how you relate to what you are doing.

I went into the Optical Communications Lab yesterday and talked to a brilliant young man, and I was trying to understand what we would get back in terms of watts invested in terms of kilobits per watt, and how this related to the crossover point between communications

in the new group universal life plan under simplified guidelines.

tions, starting at 8 a.m. on Oct. 12, 14, 27 and 28. ❑

Safety incentive program helps reduce lost time due to injuries

JPL's Security and Plant Protection Office (613) received a grand award for the largest reduction of lost time due to injury at the Lab's fifth annual Safety Awareness Seminar, Sept. 14.

"This section had the best results since 1989," according to Safety Engineer Char Rowsell. "Their five-year average of lost-time days is also the lowest—83 days. Last year they had no lost-time days or zero lost-time injuries."

The section includes guards, fire department personnel and administration, headed by Myron Hitch.

Section 613 wasn't alone in its effort. More than 350 employees from Organization 600 participated in the breakfast/luncheon, where a consultant from a local safety institute offered "a pep talk on an injury-free workplace," she explained.

Each individual was given a safety-incentive award with an earthquake-preparedness theme: a radio/flashlight, backpacks, pocket knives, or telephones.

The safety incentive program, which "encourages people to think about safety and thus impacts their behavior," has helped cut overall loss 80 percent since it began in 1989, Rowsell noted. "Each year has been a little more successful than the last."

"In the last three years, Sections 613 and 642 (formerly 643 and 645) and 662 (formerly 662 and 663) have had a 56 percent reduction in lost-time injuries," she said. That's quite an achievement, considering these three sections had represented approximately 80 percent of the lost-time injuries and lost-time days for the entire Lab. As of August 1994, they now represent 38 percent of the Lab's down time due to injury.

The safety-incentive program was also designed to control worker's compensation costs, since "such injuries in the state of California have tripled in the last five years," according to Rowsell.

The average per-claim cost in California in 1991 was $7,589. At $4,877, JPL losses are substantially less than this average, and Rowsell cites this program as a contributing factor. ❑

Medical Services making flu shots available to employees

Influenza vaccines are now available to JPL employees from the Lab's Medical Services Office, through December.

Medical Services Office Manager Dr. Donal Sweeney noted that this time period represents the ideal time to receive the vaccination, because getting the shot now will help build antibodies in time for the upcoming flu season.

Vaccinations administered after mid-December are less effective, he said.

High-risk groups for the illness include persons over 65, residents of nursing homes or other chronic-care facilities, adults and children with chronic disorders of the pulmonary or cardiovascular systems, and those who have chronic metabolic diseases. Also, people who come in contact with high-risk persons should receive the vaccination, Sweeney said.

Call the Medical Services Office at ext. 4-3320 to make an appointment. ❑

Talking Points
JPL Visit
September 21-22, 1994

The Big Picture

The Administrator has been interacting with the world outside NASA, now its time to look inward. The messages for the Centers should be upbeat, but realistic. They should address what's on the minds of Center employees: Where is NASA headed? What can I really expect in terms of funding, opportunities and job security? How does my Center fit in?

Besides providing factual information, the goal is to let Center employees see the Administrator as a real person, as one of them, as the concerned leader of a NASA/government/industry team. Employees should know after Dan Goldin leaves their Center that the Administrator is proud of them as individuals.

Themes & Messages

Four main themes are recommended: Vision, People, the Washington Environment, How-Do-We-Fit-In.

INTRO

- Very pleased to be here. Look forward to spending these two days with you.

Process

- This is the second of 13 visits.
- I'm dedicating a major portion of the next several months to NASA's best asset -- you.

• I've had to prioritize my time until now -- for many months, our focus had to be Capitol Hill. We were fighting for the Station. We were fighting for a NASA budget that made sense. We were fighting for the future of humankind's relationship with space and the opportunity to unravel its mysteries.

Survival Drove More Outward Focus

- Collapse of Soviet Union
- National Debt
- Weak Economy
- Mood to downsize government
- Rising Entitlement costs
- Other budget pressures (education, crime, healthcare, veterans, housing)
- Changing face of Congress
    - Calls in Congress to cancel space program
    - Razor thin margins
    - Perception of declining public support

Solutions

- Hold on to old program and risk cancellation, or
- Choose a path of change

- Live with a declining budget
- Rebalance program
- Make room for new starts by improving efficiency and canceling low priority projects

Results

- NASA came together as a team and we changed.
  - Best support in years from White House
  - Best support in years from Congress
  - Change in mood from American public

- My talk today is broken into four parts:
  - Vision
  - People
  - Life in Washington
  - How does JPL fit in

VISION

- There's a bright, promising future ahead for NASA.
  - Hard work
  - Willingness to change
  - The NASA of 10 years from now will be very different:
    - Less operational

- Much more developmental -- cutting edge
- Privatize routine functions
- More experimental technology missions (fly before buy)
- Assume flat budget -- no new money

- Flat to declining budget in next 5 - 10 years
  - Increased efficiency
  - Cancel weakest programs
  - Reinvest in future

- This is a sharp contrast to NASA's M.O. before federal money got tight. This will cause:
  - Creative tension
  - Quick reaction budget capped programs
  - Constant peer review

- PMC-Centers

<u>Criteria for continuation and new starts</u>:

- <u>Relevance</u>
  --Car salesman anecdote

- <u>Cooperation, not just Competition</u>
  - Space station
  - Mars robotic and human

- New launch vehicles

- Revolution, Not Just Evolution
  - Overtaken by technology
  - Small spacecraft, new launch vehicle, Station, aeronautics
  - Millennium Spacecraft, which will use technologies beyond state of the art. (Also, everything plugs together like Lego building blocks.) (JPL will lead this project)
  - Evolution was OK for the past 20 years, but the outside forces making the whole government downsize make it a whole new ballgame.

- Less is More
  - Pathfinder
  - Lewis and Clark
  - Magellan project (reduced budget by 1/3)

- Diversity in People, Places & Ideas
  - Mix junior/senior
  - Mix university/industry
  - Any location gets equal chance
  - Change peer review process to take risks

- Outreach
  - Telemedicine conference

- Town Hall meetings
- Internet interaction
- My Daily Reader, Scholastic Reader

- Do what we say we'll do

- Criteria for performance and peer review and promotions

People

- Don't fear change -- we will be with you.

- Must downsize 12% by attrition
  - No further buyouts
  - No further early outs

- We need a real dual career path within NASA. You shouldn't have to become management to get promotions.
  - Promotions will continue with dual ladder system.
  - Recognition by performance
  - Presidential directive to increase employees-to-management by factor of 2

- Change is always difficult, and it's often threatening. The way people are treated during change is important.
  - Most precious resource, treat as such

- Treat with dignity and caring
- Environment that nurtures creativity
- Gender, age, culture, physical capability aren't deterrents to contribution. You are well aware of this at JPL, I know. **Women in the workforce at JPL jumped from 5% in 1973 to 22% in 1993. Minority employees rose from 9% to 23%.** That's terrific. That's the kind of curve we should be seeing in every Center, every division, and every code at NASA.

Life in Washington

- You may not realize what <u>really</u> goes on in Washington. I guess you can't describe it—you have to experience it!

- The President and Vice President are truly committed to the space program.
  - The day the budget was released, President Clinton was here.
  - During the station debates, Vice President Gore made 3 visits to the Hill, and made 20 phone calls to members.
  - Both the president's science advisor and our ambassador to Russia also phoned members.

- We visited almost 250 members and Senators before the votes in Congress on the station. Both supporters and opponents welcomed us; they all have tremendous respect for what we're doing at NASA.
    - Dale Bumpers anecdote

- We're succeeding. The demographics of the station vote have changed:
    - 50 percent increase in support from Black Caucus
    - 38 percent rise in Hispanic Caucus.

- Apollo 11 crew in the Oval Office. The President went on and on about the size of the station vote.

How Do We Fit In?

- Remember what I said about less is more? The future for JPL, like the future for NASA, will be in small missions like Mars Pathfinder, not Cassini -- missions that are accomplished quickly, cheaply, with the very best technology, and that deliver the highest science return for the investment.

- JPL will lay the foundation for decades of space and planetary science missions, defining missions throughout the solar

system and beyond, and exploring the distant Universe with new, cutting-edge instruments.

- JPL should be defining the missions, but industry should design and build the spacecraft -- industry coming eagerly to JPL to help build spacecraft, not JPL coming to industry.

- Within NASA, JPL is second to none in technical expertise, as a mission planner, as a spacecraft developer and as a spacecraft operator. JPL should be viewed as a national treasure chest of technical strength, sought out for its skill and expertise on every mission and project that NASA and industry pursue.

- JPL should be a world-class Center of excellence. ACCEPT NO LESS.
    - Peer reviews
    - Metrics
    - Benchmark (JPL example)

- Demand excellence of bosses, peers and subordinates.

- We have to deliver on the promises we've made to the President, the Congress and the

American people. We have to do what we say we will do:

- While JPL is not intimately involved in these projects, NASA has to:
  - Keep the shuttle flying safely in the face of cost and workforce reductions.
  - Keep the station on schedule. Right now, station has Administration and Congressional backing, but slips will erode support.

- Keep finding ways to become more efficient. Every dollar you save today means a dollar we have to spend on something new tomorrow.

- Redouble your technology transfer efforts. Use joint partnerships, cooperative agreements, mechanisms with commercial centers for developing space. We want proactive, not reactive, tech transfer.

- Zero-Base Review For All of NASA
  - Wayne Littles heading for NASA
  - Leaders have no vested interest in program

- Things to Look For

- Low supervisor-to-employee ratio (2.9, 2.2, 4.4, 3.3) (At JPL, the ratio is approx. 5 to 1.)
- Similar tasks in multiple organizations
- Excess contract change traffic (120 contract mods per year)
- Redo of financial systems (16 major financial systems/subsystems designed and implemented over 7 years)
- Too many budget reports (739 budget-related reports by one organization (711 internal)
- PMS excess: 330 people needed to track 450 work elements
- 750 engineers retained by project with minimal need for their skills

- I know that JPL is currently moving to a simpler organization structure with fewer divisions and sections, consolidating functions and eliminating barriers. I applaud you for your efforts and encourage you to stick with the notion of cutting out redundancy.

- JPL also has worked to streamline procurement operations over the past few years -- reduced workforce from 200 to 175.

- We can all find savings for vision -- I know we can do it.

- Contract with boss
  - One-page milestones/goals
  - Swimming anecdote

Conclusion

- I've talked about my thoughts and vision for NASA, and I want you, in a continuing dialogue, to tell me about yours.

- Don't just show me the latest widget. I'll ask questions because I genuinely care about what you're doing.

- I am an engineer above all else, not just Administrator.

- Tell me about what you're working on. Tell me about the obstacles that stand in your way and how you plan to overcome them.

- Tell me about the risks you want to take; the dreams you dream, and the possibilities you see out there, just waiting for one bold adventurer to write them into history.

JPL All Hands Meeting
Pasadena, CA
9/22/94

I had a wonderful visit yesterday. I was just overwhelmed with the technology that I saw. And I was overwhelmed with the capability and brilliance of the people at the Jet Propulsion Laboratory, so I think it produced some very positive things.

I'd like to introduce the people that are on this visit with me. We have Jeff Lawrence, who's the head of Legislative Affairs for NASA. Jeff, you want to stand up and let them see you? He's the guy that got the bill through the Congress. Then I'd like to introduce Mal Peterson, the NASA Comptroller. He is the fellow that scrutinizes the budget and helps us work all our budget problems. He worked with the Congress very, very closely and is absolutely crucial to what we're doing in Washington. The third person, my aide Pam, is not here because I got up at 6:30 this morning to change my speech based on some things I saw yesterday. And I got so intense, I forgot all my notes in my room, so Pam has gone back to my room to get my notes. She'll be back here in a little while.

Let me talk a little bit about the process. And this is a process; it is not a business. I'm asking the Chief Scientist, France Cordova, to travel to each of the Centers to spend 2 days before I get there. Then Wayne Littles, who's the Chief Engineer, to get to the Center 2 days before I get there. For some reason, he couldn't get to JPL before I got here, but he will be here. Then I come and I spend a few days, opening up the meeting with an address to all of the employees to give you a sense of what I think on the issues and problems and the direction we should go.

I want to state some basic principles for operation and then go and talk to the employees to get some feedback. I'm not just interested about electrons and not protons. I'm interested in the issues that are hampering you in doing your job. There are things that I could do, there are things that Ed Stone could do and there are things that neither of us could do. There are some external forces that are causing a tremendous stress. We'll identify what those forces are so you don't fret over them, because if you waste your time fretting over external forces that you have no control over, it's a waste of time, a waste of energy and it'll take and zap your very strength. Where we can help you change and improve, we will do that. So it's very important that when we come around, talk to us. We don't have a big standing army. It's just Jeff and myself ,and Mal will be around looking over your books. So Jeff and myself and Pam.

After I make my visit, we'll have Jack Dailey, who's in charge of

institutions at NASA, come out. We will have spoken to a broad cross-section of the scientists and engineers, and then I'd like Jack Dailey to talk to the folks in the institutional areas: finance, administration, contracts, small businesses, what have you. Then we'll get feedback from the General on what the Laboratory feels, and then we'll take all that data, put it together and get back to you with an assessment of what we think. So this is a process that'll take a half-year to a year, and I want to emphasize, not a 2-day visit.

I also want to talk a little bit about what Ed said in introducing me. When I became Administrator, I had a real thorough plan on how I felt I would run the Agency. And the situation with the external forces which I'll talk about in a little while, just over took me. Instead of having an internal focus as I had intended, the last 2 1/2 years was spent by myself and Jeff and just hundreds of terrific people trying to save the space program.

Some people think that the issue is the space station. Let me assure you that the whole NASA space program was on the line. It wasn't a question of the vote on the space station; the question was, did America want to maintain a civil space program, with the perception that there was no need for the space program given that the Russians' competition had collapsed? It is not guaranteed now, but at least we're at some point of stability. And before the next Congress convenes, we'll spend a half year looking internally, because if the employees don't understand the direction, the forces, the objections, the goals, the vision, we're not going to be able to perform.

With all the brilliance that I see, there's an underlying fear and anger that is permeating things, [and] that causes the Lab to be somewhat dysfunctional. What we'd like to do is plan some [inaudible] and make sure that these disfunctionalities are not going to cause you to go off in the wrong direction. I also want to say that Ed Stone is outstanding. I'm going to say this time and time again. He's been giving out some very painful medicine, not because he wants to make people suffer, but because he recognizes forces that are at play. He's not doing it to hurt anyone, but he's doing it because he wants the Jet Propulsion Lab to run more effectively and insure it a future.

If you had asked me how the Jet Propulsion Lab was doing a year and a half ago, right after the Mars Observer failure, I would have said the chance of survival for JPL is minimum. So it's not just the space station. And I want to also assure you, on the good news side, there could not have been a Cassini, there could not have been a Mars Pathfinder, and there could not have been a Mars Rover Surveyor. All 3 of them are part of the budget. Let me assure you that the Washington community, in the Executive branch and the Congressional branch, looked to see things that we were doing to lend credibility to NASA's prospects, and it had a major impact.

I hope you get this message as I go through this, and I'm going to come back and repeat the same thing, because I'm so proud of what Ed and the management team and the employees here have done. You turned around Cassini, you restructured, and that saved it. You did lots of other good things and I'll come back to that. So the basic message is, NASA, JPL, have come through a very trying period and we now have an opportunity to do incredible things, change the whole future of how people on this planet perceive themselves and enhance the knowledge base of humankind. That's what we're all about and I think we can do it.

I talked about these outside forces. I want to spend some time on it, because many people here, when I talked to them yesterday, didn't get a sense about it. Sometimes there's a tendency to be isolated from the world. And living in Washington is a little bit different from living in California. In fact, I saw something yesterday called "surfsats;" I'd like to see a surfsat in Washington.

There's a tendency among folks involved intensely in science and technology to be isolated from the rest of the world. If you're not following world's events, [you] think that somehow America will never desert the space program. Somehow, some people in Washington will magically push knobs and will leave you alone to do what you do best, and that's going in a laboratory.

You can't do it that way anymore. Modern communications have changed that. News travels at the speed of light and everyone is plugged in continuously. Unfortunately electronic media don't give you in-depth reporting, so perception becomes reality. If you don't spend time reading scholarly journals, the Wall Street Journal, the New York Times, the publications from the Council of Foreign Affairs, you just react to things. The public does that. So let me walk you through some of the issues that I see and provide some context as to why some change has to come and we'll never ever go back.

JPL will never ever look like it did. You will not build very many spacecraft that look like this. You will not have $3 billion dollars in your budget. You've got to erase that from your mind. There are those who are concerned, that when Cassini gets re-staffed in 1997, what's the next big program? There is none. There will be a sum total of a lot of small programs that will have to be far more competitive and they'll have to be best in the world. And that's a lot different. It doesn't say that your going to lose all your jobs and JPL's going out of business. It just says that the environment is going to be different and you're going to have to deal with it.

There are a number of different forces. Let me deal with the first and most important: the collapse of the Soviet Union. The space program was founded in a time of violence. When President Kennedy was elected, I was still in college and

the big issue of the day was the missile gap. There was a tremendous debate; I see some here in the audience remembering, those who may have read about it in history books. There was a debate between Nixon and Kennedy over this missile gap and the United States had to make this enormous investment in terribly destructive weapons of war, nuclear tipped missiles. It dominated the thought process of the day.

After Kennedy was in office just a short time, the Russians launched Yuriy Gagarin into space. It was devastating to America, because we thought we were technological leaders of the world and we thought the Russians were off in the dark ages. They made a few bombs and they made a few bullets, but what did they know about space? When they launched Yuriy Gagarin, the technology, the system design, the engineering that went into that was a statement that said America really had a concern and was really behind.

So in that period of violence, a whole bunch of forces came together. President Kennedy looked at different things to do to counter [the Russian space program] because there was a concern about U. S. influence in the world or the Western block vs. the Eastern block. Kennedy needed a bold statement. He looked at some things in space, some not in space. Some of his advisors didn't want him to go forward with Apollo, but he did.

Apollo was more than just putting a human being on the Moon. Apollo was a unifying vision that said America was going to spend whatever it took to demonstrate to the world that we could launch bigger packages into space—with the implication that we could launch bigger weapons into space. And through the whole space exploration program—the Mariners you did here, the Surveyors, the astrophysical things we did—we were demonstrating to the world that America was technically superior. Those countries in the middle would then come into the Western block and we could defeat the Evil Empire. That's what the space program was about. And everyone fondly wants to go back to those days.

We had the 25th anniversary of Apollo, and I kept getting asked, "Mr. Goldin, why can't we do what we did in the 60s?" Let me tell you. We spent 4.5% on the national budget on space during Apollo. Now we're spending less than 1%. That is a big difference. We were concerned about the very survival of America. We used to have [mock] bomb attacks in school. You know, flash attack, hop under the desks to protect yourselves from flying debris. So the national will had a real purpose in the space program. It was part of the national defense and if you wanted to start a new program, boy did you get it fast. There was never a question about it; yes, there was some tension, but it was a different time. We're never going back unless we have another tradition like that.

So it's very easy for the press, it's very easy for people to criticize the NASA work force and say they don't have the vision we had back then. We didn't have the driving force back then: survival. That changed everything. And this, I think, is one of the key factors because we're so uncertain, because all of society is undergoing change, people try to find culprits. The budget is much less, the conditions are much different, yet there's a sense of people that work on the space program are less than competent. That they're associated with waste and failure.

If you read the press for the last 3-4 years, [you read about] "the troubled space agency." I think in the last 5 years, we've had 55-60 successful launches; we've had just a few failures. But the focus went on the failures because America needed someone to grab on to. Not that Americans are bad, but when there's uncertainty you look for someone to blame, and I think this has caused part of the frustration and this has caused part of the anger. You're getting a lot more oversight because if there is a perception of waste, the American public is going to want to understand, and that's where the oversight comes from. It doesn't come from Ed Stone wimping out and telling the GAO they can't come in here or the IG they can't come in here or DCA, that would be absolutely wrong. If the American public wants to have studies of what we're doing and do all sorts of things to understand, we have to welcome them with open arms. Your leader is not wimping out. He is doing the right thing and I'll talk a little bit about that later.

To just give you a sense, this change happened at the speed of light. The Berlin Wall came down in '89. Gorbachev dissolved the Soviet Union in '91. In '91, Norm Augustine headed up a panel with a study that started in '90 to see where the future of the space program would go. And the same year, Augustine came out with a report. His panel called for a 10% increase in the NASA budget, spread out over the next 10 years. The NASA budget would double and be close to $30 billion dollars by the end of the decade.

These are very brilliant, perceptive people. But who knew that Gorbachev was going to dissolve the Soviet Union when they were writing the Augustine report? They talked about science was the most important thing that we do and we're going to have all these scientific missions, we're going to have new starts and there was a feeling of euphoria at the Jet Propulsion Lab. At NASA, we had the space exploration initiative, so to go to Mars, we'd have all these precursor missions to Mars that were robotics and made up at the Jet Propulsion Lab. We were going to have new launch systems, and the space exploration initiative was only a half-trillion dollars. A half-trillion dollars....

There were some optimists who thought it could be done for only $250 billion or a quarter of a trillion. It seems funny now, but it wasn't funny in 1991. When President Bush announced it, he was dead serious, because we had

to show the world that America could be superior to any other country with the infrastructure we could put in and win the battle.

I went to Russia in 1992. I was appointed Administrator on April 1, 1992 and within a few months, I think it was September, I went to Russia and I went to the Ukraine. They took me into the weapons factory that I spent the main portion of my career targeting. Now think about that. If you don't know what the SS-18 is, it is the most destructive weapon in the world. I walked into the SS-18 factory, in [inaudible] in the Ukraine. I couldn't even mention the word, and here I was walking the factory and they showed me their welding machine. If I asked a question about this, they showed me that. "What do you want to see?"

So when, all of a sudden, the Congress was screaming to cut the NASA budget or perhaps eliminate it, they weren't doing it because they disliked NASA or what you've done. You've done brilliant work. The issue that was driving the members of Congress was that the world had changed. They didn't understand why we need a space program, because they were conditioned. The reason for a space program is to beat the Russians. Just pick up some of the literature and read it. People said, now that the Soviet Union's come apart, why do we need it? The focus of the attention was the space station but let me assure you it was broader than that. And Ed, I don't know, who probably lives in Washington and cleans his laundry in Los Angeles, he was back in Washington all the time trying to save your program. So, it was a very broad issue. So the Soviet Union coming apart was a big deal. A big, big deal.

The second issue: national debt. The Vietnam War changed America completely. When it started, our industrial output was enormous, our manufactured goods were sold worldwide, our value-added businesses were super high, our balance of trade was fine. Then something funny happened. All of a sudden, our balance of trade went negative; and instead of driving cars built by GM and Ford and other companies in America...just take a look at your parking lot today. You can't even buy a VCR manufactured in this country.

So as a result, Americans went on a buying spree. Our whole psychology changed as a result of what happened in the Vietnam War and the buildup that came after that. So we had a huge national debt. A major reason—not just the economic reason—was we had to have a defense budget that was beyond belief. The United States provided the nuclear umbrella, and when the President of the United States showed up at a meeting internationally, everybody stood up because they were underneath the American nuclear umbrella.

There was just an article after the last G-7 summit that said President Clinton didn't get the same respect. It wasn't that President Clinton wasn't a great president; it was that the nuclear umbrella isn't such a strong issue and

now there's a lot of [inaudible] and shove economically; who's our partners and who's our competition? I don't know. But it's not in their interest necessarily to treat America in the same way that they've treated us before. Again this is when people want to go back to the good old days. But the good old days of the nuclear umbrella aren't necessarily there.

So here we have this huge national debt and we have the budget cap. That was the response a year ago in '93. The Congress put a cap on that budget, locked at $1.5 trillion a year. So you say, "we want to start a new program , the Pluto Fast Flyby." They come to me and say, "Dan we've got to have that program." It's not under my control. There's a cap on the U. S. budget, there are enormous pressures. We have to provide reasons why we're necessary. There are people starving. The economy is in trouble.

The entitlement programs are growing by leaps and bounds because the American public wants it. Half the U. S. budget is entitlement :$750 billion a year. A quarter of a trillion dollars goes to paying off the debt, so now we're at a trillion dollars. The defense budget, although it came down, is still at a quarter of a trillion dollars; now that's $1.25 trillion a year. So, 5/6 of the federal budget is really capped with entitlements growing. This is why there's a health care debate.

So with the cap at $1.5 trillion a year, you deal with domestic discretionary spending, where NASA is. In domestic discretionary spending, we have veterans who have lost their limbs in war. Do you turn them away? That budget goes up at 8% a year. Housing and Urban Development, the EPA. When you really get down to it, maybe about $100 billion a year is what the Congress operates on to try and deal with all these pressures. So it's not that they're against NASA, it's not that they're against what we're doing. There are enormous financial conditions in the country and there's one message: The NASA budget has to come down.

When I took over as Administrator, we had this momentum model for the budget. I kept telling people we can't go on like this, and they thought I was a bad guy. I love everything in space, I love everything I see, but the reality is these issues that are playing here. So, when someone at JPL wants to start a Pluto Fast Flyby, where's the money come from? We have to cancel something. The budget at NASA is not going to go up because of these forces. We're not going to make it go away; this is going to be a condition for the next 5 or 10 years no matter who is in the White House.

We have a weak economy. It's hard for America when the economy is weak. It's recovering. It's a lot better today than it was 2 years ago, but it still hasn't got the robust stance that it had in the good times. I have a house in Southern California. I can't sell it. I just can't sell it. So, when there's a weak

economy there's a perception about relevance in the NASA space program. Everyone in America once understood we were going to beat the Russians. And now it's not quiet clear to Americans why we have a space program. So can we afford to have an increasing budget at NASA? Again, we just can't start things unless we can get more relevance to the American people and understand that the science community is not our customer. NASA Headquarters is not your customer. The American people are your customer and we've done a rotten job in communicating with the American people. We do a terrific job communicating with the highly educated, but not with the broad population of America, so is it any wonder that with all these forces the NASA budget is having problems that it does?

There's a mood in the country to downsize and change government. The 1992 elections sent that message loud and clear. If you think reinventing government is a toy or a joke, come to Washington and see how real it is. Mike Mott, who is the Chief of Staff at NASA, went to the White House to a meeting with all the Deputies of all the agencies and departments of the government. If you think NASA is undergoing tremendous change and stress, you should see what's going on in the other agencies. The federal government going to be at the smallest level it's been in, I think, 2 or 3 decades.

So when Ed Stone is trying to downsize JPL, he's taking a Presidential directive. The President is taking direction from the people of the United States. So there's not any move afoot to cause pain and suffering, but the American people, our customer, want government smaller. We believe in what we're doing but we're going to have earn every last dollar. We can't drop a fish hook into the ocean and have someone put some money on it and start a new program anymore. To start a new program, we'd better get more efficient or cancel something. By the way, if we just want to stay where we are, we're going to have to do that in any case, because at very best our budget is going to be constant without [inaudible] for inflation. So we'll lose about 3% a year.

This is a reality, but it's not that you've done a bad job. You've done a brilliant job. You've been part of some of the most important things in history. But now change is coming. How are we going to deal with that change? I talked about rising entitlement costs; there's one other factor. They call it the changing face of Congress.

When Jeff first took this job, and he's a political appointee, he worked for President Clinton, just like I did. I said, "Jeff, could you give me a history and tell me what's the distribution of votes that we have in the Congress based upon years of tenure in the Congress?" It was very interesting. Those that support the space program had from 12 to 20 or 30 years, depending on the Congress. They were part of the Kennedy buildup. They understood, and more than just the competition aspect. They were an integral part of the program. They shared

our success and they cried with us when we had our failures, but they understood.

The members in Congress between 6 and 12 years were lukewarm for the program. The members between 0 and 6 years, generally voted against the program. Now it gets worse. In the last 2 years, last year, in the election of 1992, over 100 members of the House of Representatives turned over and the projection for 94 is another 100 people are going to turn over. These are fresh new faces. People who are coming in because the incumbents lost. People who are coming in because America wants change, America wants a smaller government, America wants a government more responsible and more relevant that's going to deal with the issues of the country. They're not going to deal with tradition. They're not going to go into some nice room where you could smell the tradition. They want change. That's what America wants.

The number of women elected to the Congress is going up by leaps and bounds, and I think that that's beautiful and wonderful. The size of the Black Caucus is increasing, the size of the Hispanic Caucus is increasing. Congress is more representative of what America looks like and many of the women, many of the minority Americans don't feel the space program has been responsive to all of America. The image of the space program is Mission Control at JPL or Mission Control in Houston. And generally what you see are white male, with white shirt sleeve shirts. And I'm not saying that being a white male is bad, but what I'm saying is that if America owns this program—and they're our customer, the National Academy of Sciences is not our customer—if this is their program, they darn well better feel that this program belongs to all Americans and the program [better] look just like America.

There's another stress at JPL. You know "Crazy Goldin" is at it again; why is he forcing small disadvantaged businesses down your throat? Why do I call for diversity? This is America's program and by God, every single American who wants to participate in it and has the skill will not have gender, or culture stop their ability to get in or stop their ability to get promoted. I don't think there's any malicious segregation but there's a tendency on the part of my generation to look upon people and form some image of what they ought to be. And if we recreate the management structure in the image of 25 years ago, that's a self-fulfilling prophecy: white middle aged males.

Don't be angry, participate! It is crucial. It's not only important for this program, but it's not like we're the Agriculture Department. Not very many people watch the Agriculture Department or watch the grass grow. They do good work; I don't want to demean it. But when we have a launch, when those comets slammed into Jupiter, you had billions of people watching. Now if billions of people watched only white middle-aged males, it's not right. I'm not saying we ought to take out the white middle-aged males and replace them. I'm

saying you have to have a diverse workforce. It is immoral, it is wrong and it is not as effective.

These are the forces at play. You can get angry about that or you can say the American people have decided what they want out of their space program. We're not going to tell them what we want, they're going to tell us what they want. I'll give you a little story. I talked to people about this unifying vision, about what the next major mission might be. Someone said, "No you can't have all the discussion. We've got to wait for the right point in time and then tell the American people what they're going to get." Do you understand? This is the issue and this is how we have to deal with the space program.

So what's the impact of all these things I talked about? First, there were calls in the Congress to cancel the space program. Some people somehow thought, if we can get the space station canceled, boy, will we have money to do the things that we want to do. I'm sure nobody at JPL went in and tried to get the space station canceled, but let me tell you, the American public—whether you believe it or not—want humans in space. They're our customers. They want a balanced space program. They want to see humans in space but they don't want to spend a lot of money on it. They're not interested that people make their careers doing wonderful things exploring esoteric issues. Understanding the science. Americans want a program that is relevant to them and they also want to share the excitement with human experiments.

So if anyone in this room, anyone in JPL, anyone in the science community, believes that by canceling the space station they're going to get a better set of situations here they're wrong, and again, that's immoral. By what rights should you work to protect your jobs when this program belongs to the American public? We have to be responsive to them. They don't owe you anything. They just want to get things that can inspire them, that have their children want to enjoy math and science. They want to understand creation in the broadest sense, the crossover between cosmology and theology. They won't understand how the solar system formed. I mean this is the nourishment of life, that's what's important. They want to share through the human experience, so when people think if you cancel one thing to protect jobs, it's going to backfire. It will be a disaster.

We are striving to have a more balanced program, because the human spaceflight account took up 50%. We now have it down to about 38% and I hope that we can get it even lower and we can increase the science portion, because I think, again, that's what the American public wants. At those town hall meetings, that's what they told me. So there was a call for cancellation.

And then we had the Hubble problem. We had had the Challenger. People kept repeating about the troubled space agency. One evening I had a dinner

party at my house. I got a call, and they said, "We lost Mars Observer." So, I said well, do what we have to do: Call the Press, let's be very open with them. We had a failure, let's just say it. Let's not pussy foot around. Within 8 hours, we lost a weather satellite. And then the Department of Defense launched a classified spacecraft for a billion and a half it went into the drain. You know what the first headline was? "NASA Loses Another Satellite." You see, the public identifies space with NASA. We are an unbelievable inspiration to them. Anything that happens in space, they give us credit for or they beat us up.

But it's wonderful. I'm thrilled that that happened, because it is a sense that America really wants a space program. But it did not help our condition when we had those failures.

The most important thing when you have a failure is you say, "Hey, we had a failure." You don't start making excuses that it was Headquarters' fault. In fact, we had a discussion last night. A woman spoke openly: "Why are you ruining the reputation of this lab? I said the lab is accountable and responsible for the Mars Observer. It failed. Stand up and say, "Hey boss, it failed." If there was something wrong, you should have called it out and said we shouldn't have done it. In fact, Ruth Bettler, head of the board of trustees, told me JPL will never take on a contract on like that again. I think that that's very healthy.

If we at Headquarters or anyone forces a contract down your throat, that's stupid. Just say no. I'm serious about that. You'd better not take it, and when the problem occurs, say you have an excuse. No excuses are acceptable. This is a subject of accountability and responsibility.

So we got a wake up call a year ago. The space program passed by one vote. Notice I didn't say "space station." The space program passed by one vote. There were calls to cancel Cassini. There were calls to not start the Mars [inaudible], and there were also calls to not start the Surveyor. But we communicated with the American people and the Congress, and I'm happy to say that for 1995 we won by 2-1 in the House and the Senate across a broad coalition. I hope today that they'll actually get the bill; it's been ratified in the House, now it has to be ratified in the Senate.

That's the impact. What are the solutions? We have two choices. Everyone in this room votes. You vote with what you do around the water cooler, you vote with what you say to your fellow employees, you vote with how you feel. "Hell no I wont go, I want to hold on to the old program. I want it the way it was." Or you could choose a path of change from the old way. And when auditor comes in, you say, bless you, we need you, we'll do everything you want. I say that half seriously and half in jest. Because if you tell an auditor you're not welcome, and you say the right words and have the body language, how do you think they're going to feel? Do they think you're trying to hide something? I think so.

They're doing their job. They've been asked by the Executive Branch and they've been asked by the Congressional Branch to review what you're doing.

Let us say across NASA—and I include myself when I say it—our record is not stellar. Our record of overruns is beyond belief. Our record of not delivering on our promises is very open. And there's a sense that all we have to do is get it working and [inaudible] that will never occur again. The American public wants a lot more from NASA. So we'll choose the path of change, we'll learn to live with a declining budget and we'll make the most of it. We've got to re-balance the program so things are in balance between technology and science, big, small, humans and robots. And we'll make room for new starts by getting more efficient, by making drastic changes in how we operate. We'll cancel the sick programs and we'll prioritize. Darwin is going to reign supreme at NASA in the future. Survival of the fittest is what it's going to take.

I believe it's going to make the program stronger. No longer will we be able to allow mediocrity in some areas. I don't think the mediocrity comes from the people. We in management have given you bad systems. They're not actually bad systems, but they're outdated systems. You don't fail, we fail you. The systems we have in place were designed for the period when we were going to beat the Russians and getting things launched was most important. Not necessarily the costs, although you got beat up a little bit and all was forgiven because we showed the Russians. But in a new operating mode, this is no longer acceptable and again, I understand your frustrations.

Don't take it as a sign that you have failed, especially at the Jet Propulsion Lab. You have some of the most brilliant people in the world, and your capability is second to none. But again, when the country's in a negative mood, the employees generally get criticized and you take it personally. I'm the Administrator, and I'm telling you you're outstanding. I see what you've done. It's wonderful. We have failed you with systems that are outdated, we've got to fix those systems.

So, I believe that we're on the right path, that the change is here. It happened so fast no one even saw it coming. Norm Augustine in '91 didn't see it and it happened in '92. In November '92, change occurred and the Americans want to move forward. And the President is in the process of making this change happen. We have the best support in decades from the White House. The President is engaged. He spends an inordinate amount of time on this program. The Vice President is engaged. He went up to the Hill three times. I don't know how many tens of phone calls he's made. The President and the Vice President have invited the leaders of Congress into the White House. They've involved the whole U. S. government. We have a priority that's way at the top.

During the celebration of Apollo, we had Michael Collins, Buzz Aldrin and

Neil Armstrong. I was in the oval office with the President and these three great Americans and the President couldn't stop talking about how proud he was of the tremendous report of the space program and the vote that we had. The Congress gave us a 2 to 1 margin. People at OMB are giddy. They know what you're doing. There's a tremendous excitement and I believe the American people are changing their perception. Just look, we're no longer called the "troubled space agency" because of what you've done to change. Even though there's concern, you have sent the right signal. You wouldn't have Cassini, Mars Pathfinder and Mars Global Surveyor if you didn't change. You're the ones who really did it. Ed was the spokesperson, but you actually did it.

This is my introduction and I have been talking in four parts, so I'll try to sieve through. Just be patient. But I felt it was crucial. The rest of this stuff is not as crucial as the first part, because you [have to] understand the forces at work and you [have to] understand how essential it is to change. Everything else is flute music; you deserve a rest. So now I'm going to give you a few words of wisdom—and none of this is sacred. come at me during the day if you don't like it. Talk to Ed, talk to your supervisors, talk to your mothers and fathers, but get the word back.

We'll talk about the vision, a generic vision for NASA, what a new operating mode will be. Then we have seven basic operating principles on this board; I'll talk about that. People issues and how does JPL fit in.

First, if we perform and if we execute with the talent pool we have, I believe we have an unbelievably bright promising future with no security, because we'll have to earn it through proving theory. On our path towards consistency, 10 years from now NASA will look very different. We are much to focused on operational issues and institutional issues. We have much too large a fraction of our budget dedicated to that.

Look at Wes Huntress' budget ,which is space sciences. Space science has about 1/3 of its budget in operations. What a waste. Why should we have people sitting at consoles in 1994 when we have the wonderful technology I saw just yesterday? You have the technology here to almost eliminate these operational costs. I would like to see you launch a spacecraft called autosat that's hands off. Why do we need people even talking to a spacecraft when it's on a 10-year voyage?

We have the technology to do it. I took a look at some of these frequency [inaudible], and it boggles the mind. You put them in the spacecraft. Then in the micro devices laboratory, I saw this camera that does all the mission planning for you. You don't need a team of mission planners. It could look at the planet and pick out all the key features, automatically, no people involved. So why not take that money and spend it on development?

In the 60s NASA was a developmental agency doing bold exciting technology, braving technological barriers. Now take a look at our workforce; we have a whole bunch of people. You could fall asleep looking at some of the things they're doing. Now, I'm not saying everyone at the lab is doing operations or institutions, but let me give you some evidence. Mars Surveyor was supposed to be faster, better, cheaper. Everyone thought they were doing the right thing. This is not the way to do things. There is no excuse for all this paper in that package and what this package pulled out is the famous JPL procurement forms manual.

Do you want to spend your remaining days in the space program dealing with garbage like this? Who has the courage to say this is unnecessary? This is not what we're about. We're about leaving Earth, we're not about paper.

You know how this came about? JPL got started, and I can't remember the numbers What was it? Nine months? It was a number that boggles the mind. We had a few problems, so we said, "Oh we've got to avoid those problems. Lets get a little book, or a bigger one with depictions of our most recent stars." And we never go back to the beginning to question why we're doing what we're doing.

There's a group down South—I wont identify the project—they had 200 people trying to reduce touch labor. They were doing this for 25 years and someone actually asked them, why do you [have] 200 people reducing touch labor? You know how many people or touch labor you're trying to reduce? And guess how many people in touch labor there were? 200. I mean, I want to cry.

This is not what we're about. Yet when I ask for the budget to be cut, I'm told it's going to impact safety on the space shuttle and it'll destroy reliability on these other flights. I think that's a bunch of crap.

Let me give you another one. This is not from JPL, but it could be. Here we have a quarterly financial report Form 543. There are more work codes in this than the number of people working on the jobs. Nobody read this report. Then the U. S. Congress and John Dingel of the Oversight Committee are investigating NASA because the contractors are not coming clean on when they have overruns. But everyone says, "Hey I did my job. I'm safe. I spent $60,000 dollars on this report. It's all documented." It isn't worth the powder to blow it to hell. This doesn't have anything to do with shuttle safety or quality of the voyage of spacecraft. This is about deluding forests.

This operational stuff and this institutional stuff has to go. I submit that you could eliminate 1000 jobs here and convert those 1000 jobs into going to Pluto, into going to the Sun, into building interferometers that might actually

take a picture of a planet around a star. Wouldn't that be more fun than being angry and frustrated every night?. This is the issue, and it has nothing to do with your brilliance or dedication. No one is willing to question the requirements that we're operating on, and you have to have some courage to question. Remember, question authority. You've got to do it, and if you're afraid, you don't belong here. I'm being very harsh and very severe because I'm worried about the future of the space program. JPL is not about this stuff, JPL is about that stuff!

We have to continue technology investment. Our technology program was measured in bits and pieces. We are going to have a new technology program that's called a New Millennium spacecraft. Ed Stone and I had dinner 2 months ago, and I said to Ed, "Why isn't JPL the best in the world in planetary science and large astrophysics?" We went through it, and we are not investing. We had Catch-22. You build spacecraft and the program manager says, the program is so big and so long. You come to the program manager with a new wicket and the program manager says, "I can't fly that cause it didn't get tested in space." And you say, how is it going to get tested in space if you don't fly it? We're going to break out of that because we're going to make an investment.

Now, I'm going way out on a limb, this program isn't approved, but I am absolutely committed to carrying it forward. If we do it, by the year 2000 we could launch 10-15 spacecraft a year— not a decade, but a year. Won't that change the face of the space program?

We need more experimental craft. When we built this, it cost a lot of money because we had to check it out on the ground and we had to do a lot of analysis. What if we build some experimental craft and test technology and launch these things all the time? That's what you're going to do. Talk to the folks over in micro-devices center. They have unbelievable concepts. So let's get away from this unbelievable constraining Catch-22 and we'll have experimental programs. Not just the spacecraft but for launch vehicles.

I made a commitment to Ed Stone that if we want to have 10-15 launches a year, you can't pay 20-30-40-60 million dollars a launch. We're going to try to get a new launch vehicle on the order of $5-10 million. We're going to start this up. Now, how are we going to do it? I testified before the Congress that our highest priority is a new launch vehicle, a new start. And our next highest priority is new money in spacecraft.. So we're going to cancel something. And the peer review and Darwin is going to have to reign supreme. I'm going to try and get it started.

But it's going to change the way the agency will look. We won't have vast control centers with hundreds of people doing these things. We'll have people in a development stage, in an experimental stage. That's why we want JPL. We

don't want a production facility here, we want you to grill your minds to go to the next frontier. Peer review dominates. So, let's talk, look at the criteria for new sets of peer reviews. And by the way if you have better ideas, we need to know that.

So first relevance dominates, no longer survival. Will it be a benefit to America? Will it inspire young people? Will it provide a new level of knowledge for humankind? Will it provide technologies to spur new industries? Will it involve America? These are the questions of relevance, not, "Is this a great scientific task, or do I love this widget to death?" This is going to make us look more competitive than someone else.

Secondly, cooperation, not just competition. The world has changed. A weapons builder walked into the weapons lab of the enemy. So, we're going to have to work with other countries and I think JPL is right on target. You're talking to the Russians about a program called Mars Together. Why should we have common infrastructure? If we have to put up the same things as the Russians for infrastructure, we have less money for designing spacecraft. We'll also have to work closely with other government agencies and JPL—we're going to have to help you. There were some complaints yesterday that NASA is causing you to have an "at arms length" relationship with industry. We need you to get closer to industry. You can spur economic development in this nation beyond belief if we empower you to do that, so we'll have to figure ways to do that.

Revolution not just evolution. Relevance has been overtaken by technology, so we're going to have revolutionary new technology. I'll give you an example. After Ed Stone and I had dinner a few months ago, within 3 weeks he walked into my office and said here is the replacement for the MESUR mission. Keep in mind that 2 years ago JPL built the MESUR mission to cost a billion dollars; we'd have these landers, retro-landing on the planet without using parachutes.

He showed me a one-pound spacecraft where the payload was the size of my fist. Something that might be built for hundreds of thousands and you drop them out of the Surveyor spacecraft all over the planet and you could make meteorological measurements. Yesterday, they said they could even make seismological measurements. So you could literally reduce the price of that mission with technology as an enabler and really get the data we wanted. MESUR would have provided a lot of security and a lot of jobs, but the new approach is going to open up science on Mars and on other planets that have an atmosphere. So technology is an enabler. It is crucial, but the problem was we at Headquarters, and we at NASA, did not make an adequate technology investment in JPL. With Ed's leadership, we're going to try to change that and fight that battle this year.

Less is more. Remember I said the budget is coming down? Just take a look at what you're doing on Pathfinder. That's 1/20 the cost of Viking. You're doing a lot of good science for a very valuable mission.

The shuttle has landed. The people at NASA Johnson built this thing called SAFER. It's a jet pack that hooks onto the life support system—$7 million. The prior jet pack was $100 million . This does the job of 90 pounds up to 400 pounds.

Diversity in people, places and ideas. This is something I will not yield on. I believe you will not want to yield on it either. And when your program comes up for peer review, if the program has not touched a cross-section of America, it will be marked down. Companies are told when they bid on programs. I personally had to change the Discovery proposal; I worked with Wes Huntress to make sure we called for diversity. Are you involving a cross-section of America in this program? Not people who aren't qualified, but people who have the right to be there.

We've had a tendency in the past to say, "Show me your experience and then I'll see if you get the job." How in the world are you going to get the job if you don't have all the experience, but you have the human potential? You have a demonstrated ability to do things, but maybe not in those categories. It is crucial. I can't emphasize this point strong enough. And I want you to understand in those magnificent scientific projects may not make it unless you accomplish this.

There are some outstanding minority owned businesses out there. I worked with them. When I was at TRW I was told, "Dan, how could you involve the small disadvantages businesses over fine quality [inaudible]. I said, they have built ground quality modules, and all we have to do is keep some NASA soldering and some of the flight procedures. There was a revolution in manufacturing, and they said we're going to destroy the program. I want to tell you, this company delivered on time, on budget, with equal or better quality. Not that they were just getting a free reign—if they don't perform you can't build confidence—but you've got to change the way you look at people and look at things.

We cannot go on this way in America, not just in terms of gender and culture. There are people in North Dakota. They have a wonderful aerospace institute there. They are locked out of the space program. Most of the activity in the space program takes place in California, Alabama, Florida and Texas. That's unconscionable. We have to open up our minds to new ideas and not lock them out because they're not part of the old boys' network. Think about it. I know I'm coming on real heavy, but most of us are comfortable with those we

know and uncomfortable with those we don't know, and don't give those we don't know credibility for having the capability to do things. The U. S. Congress doesn't look lightly on this old boys' network and we've got to eliminate it from our thinking.

Outreach. In our town hall meetings and talks with the members of Congress, we're getting universal feedback that NASA is not communicating. How many people go through My Weekly Reader or Scholastic Reader? I did. How many people wrote an editorial for their hometown newspaper to explain to them the beauty of what you're doing, to share your experience? If I said, how many wrote in the scientific journals, I bet almost every hand would go up!

This is not the job of the Administrator, this is not the job of the Public Affairs office. I called Public Affairs—not a nickel of propaganda from NASA. That has been our problem, but outreach comes from everyone in this room. And if you don't do it, it is not going to happen. It's kind of like water on the [inaudible] when you do these things. You will improve the quality of people's lives when you talk about what you're doing.

My final principle is do what you say you promise to do. Don't rush into a job. Don't have a job where you haven't worked out requirements in advance. Don't pick a schedule that you don't clearly understand. Don't pick a budget or a funding profile you don't understand. Say, "I'm not ready, and if you want to force it down my throat, go some other place."

The new rule is, you've got to do what you say you're going to do. Now clearly, if you're going through the frontier scientifically and we have a scientific problem we couldn't anticipate, I'm not talking about that. I'm talking about broken promises. I'm talking about overruns due to mismanagement by not by people but by systems. The Congress is very serious about us doing what we say we're going to do and we can't constantly slip launch dates and we can't constantly slip costs and change what we said we are going to do. That is probably more important than anything I said. It is crucial.

I spoke to your Cassini program manager. And there's a little problem here, because I talk about taking risks. But let me tell you, we cannot afford to have Cassini fail. I'd love to tell you there's lots of room for margin, but I also want you to know that when the debate started, I wanted to cancel Cassini because I thought it was much too big, much too complicated, it was taking all our eggs and putting it in one basket. If the launch vehicle failed, all the beauty of that mission would go away, and we're going on a relatively new launch vehicle. If the payload failed, we would not have the hope of the country, and $3 billion dollars is a lot of money. There was an outpouring, there was an outcry. The scientific community wants it, our international partners said we've got to do what we say we're going to do, and that's why I decided to go for it.

Because when America gives it's word, we've got to live by it.

The Jet Propulsion Lab desperately wanted this program to perform, and I'm holding you accountable for the launch vehicle, and I'm holding you accountable for the payload. No excuses. Better understand the launch vehicle now. It had an opportunity to go on the shuttle, but you selected the Titan 4. So you can't go and say "Hey, everything's okay, the Titan 4 failed." Setting the rules in the game right up front, so if you need to do penetration of the Titan 4 Centaur, do it. If you have to understand every diagnostic existing in the European payloads, and have them understand every diagnostic existing in our payloads, go ahead and do it, but do it now. Don't set yourself up for an excuse.

I'm being very tough, but I believe I understand the sense of the U. S. Congress and the American people. All you have to do is listen to a few hearings that I was testifying in and see what was, dished out in terms of the intensity of this hearing. I put my hand on the bible and I said, we're going to launch Cassini, but you are accountable. The program manager here is accountable and responsible. Ed Stone is accountable and responsible. I'm saying this up front so there's no question later on, not because I want a failure but because I'd like you to put in the intensity now, and do what's right now, and not later on come and say I wish I would, I could, I should.

I'm concerned about Mars Pathfinder. Some young man yesterday said, "Mr. Goldin, you can't expect us to guarantee success. It's a class C5." Hey, we're spending $71 million plus $60 million for a launch—a quarter-billion dollars! Wake up and smell the coffee. We don't have 10-15 launches a year. We've already failed on Mars. I wish it was different, but we're going to live under the eye of a microscope and I say "we" because I join with you. And we're going to have to produce on those three programs.

Now on the New Millennium spacecraft . We get nirvana at the turn of the century and we launch 10 or 15 spacecraft a year, by all means we could fail 3 or 4. Not because I want to, but because we'll have diversity in function and number and it'll be okay. I want you to understand this concept of risk. Take the time now and don't set yourself up so you can make excuses later. Do what you need to do to make that parachute system work. I understand that it's a few months behind schedule. Don't take shortcuts. And if you've got a problem say it; if you're overrun more than 15%, we cancel it. I want you to be sure you understand the rules. This is how Darwin works. Now I'm not saying this to warrant problems, but I'd like you to respond and do the things that you need to do.

Okay, now let me get to the vision. I want to get all positions behind us. Now the fun stuff. We are going to explore the solar system and the universe as we've never explored it. We're going to have flyby missions, we're going to have

orbiters, we're going to have landers, and we're going to have samples returned. I was just at the moonwalk wall in Houston and I said, "How much more room are you going to have for rocks from asteroids and comets, and how much room do you have for rocks from Titan and some of the other moons in the outer planets? And they said, "Mr. Goldin we can move this equipment over and we have lots of room."

This is what you're about. By the year 2000 you ought to be launching these missions. I believe you could have a sample back here by maybe 2003, 2004. Now maybe it wont be hundreds of pounds; maybe it'll be a hundred grams. Imagine what you could learn. And you could do it. If you haven't seen what's going on over in the micro-devices center and you want to see the face of the future, go over there and see. They have a spacecraft on a chip. It's literally the size of a silver dollar and you just drop a whole bunch of these things through the atmosphere and you could make magnetic measurements as it's falling through the atmosphere. This is what you're about. And we are going to do whatever it takes to get you the resources to do that.

I also believe that astronomy and astrophysics is good, but not outstanding. There is no reason that we shouldn't be able to image the real resolution. Yesterday they said, "Dan, you build this interferometer and we could image a planet ,and before that we can infer that planets exist around stars." What were they, within 10 parsecs by looking at the curvation of the stars orbit? I said no, I want 25 kilometer resolution. But could you imagine if we did it?

Now let me tell you what you got here if you don't know about it. You're among the world's leaders in nominal [inaudible]. Right now the problem in building astrophysical observatories is you've got blown glass. But if you have correction for the phase aberrations and you don't lose bandwidth because you've got to count photons, we could make El Cheapo reflectors. It's been holding us back. Ultra -lightweight, ultra low cost and it's right within our fingertips. Maybe what we got to do, Ed, is make this part of the New Millennium spacecraft and not just say it's planetary, but we'll open the definition of planetary and say planetary is to do real relative planetology.

Again, I know of no other place in the world that has the capabilities to do this than the Jet Propulsion Lab. I'm not talking about 2030-2040, I'm talking about these things that could happen in 10-15 years. This is within your grasp if you decide this is not what's going to dominate my thought process, but I'm going to convert that money into doing the things that I just stated. You are flying circuit densities that are decades old on the very spacecraft you have now, on Cassini. You take a look at what's available now, you take a look at the software you have on it. You're flying aluminum. Why not injection-molded bodies? These are things you've got to do. How about expert systems in these

new cameras?

I believe—and I'm laying this on—the Jet Propulsion Lab is going to be the catalyst to change the whole NASA space program, the whole world space program. The only way you're going to do it is to decide you're going to get over anger and over frustration and over fear and you're going to say what a privilege to work here. Yes, the standard of living is going to go down, but the standard of living in America is going down. The standard of living can't go up at JPL while it's coming down in America. I know that there's been a salary freeze. I know that we've had compression in the management ranks. I know that there are restrictions on travel. But what a privilege. What a privilege to be able to work on these things. I mean I get goose bumps just thinking about it. You could change the way the human species looks at themselves and you could do it within your lifetime. This is what I see as a vision of what we could do.

Let me say further that we have four things to do before we could send humans into space again on a major mission. We have to figure out how they could live and work safely in space. There are some unbelievable problems to overcome. What happens when heavy ions, cosmic particles, rip apart the genetic code? How can we responsibly send anyone out of the protection of the Earth's magnetic field into space before we could do that? How do we screen people so they wont develop cancer or heart disease on the trip? We're going to be on the cutting edge on genetic engineering. We have to be careful not to violate the rules of ethics. But we have some incredible things, we're going to be even looking at chemical and genetic surgery because you can't afford to take an operating room on a spacecraft.

This is what the space station is about. It's not about jobs. It's not about maintaining stability. That's what we're doing. And also on the space station it's a cultural test bed. We're going to learn how to work with Russia and not point weapons at them.

Third, we've got to do these missions not for a half-trillion but for $25 billion, and not in 30 years but in 8. The technology to a large degree could come from here. The most successful exploration missions have been living off the land. You're working on a concept to convert the Martian atmosphere into breathing gases and fuel to return to Earth. How about in 2002, we land a breathing gas station and a fuel station, a robotics station on Mars to see if that works, and not do it for a half-billion but do it for 50 or 100 million? Why not? You could do it. You could allow the human species to leave Earth orbit. Everyone's tired of the shuttle going up and down. Boring. Who wants to spend $4 billion dollars a year to go up and down? We have to get out of Earth orbit.

Finally, the fourth condition is precursor missions. We could explore the

asteroids and the comets. We can put a space station on an asteroid. Everyone's interested because what happens if one bumps into the Earth? Just look what happened with Shoemaker-Levy on Jupiter. So we have to have an exploration mission robotically to the asteroids to understand their composition. Do they have water content? Could we convert the water into fuels and breathing gases? Are there hydrocarbons there? Are there minerals there? What should we do with them?

Another possibility is to go back to the Moon and do a lot of scientific research and perhaps some commercial activity. We could go to Mars, which is fascinating because it may help us find some fossilized life that exists. We're taking the first step with Pathfinder.

Maybe the next big mission is to get—do we have that picture here? You want to put that picture up? This is 25 kilometer resolution of Planet Earth. Now, ask yourself, what if the unifying vision for NASA was to take a picture of a planet within 10 parsecs of Earth with resolution like this? I can hardly talk right now I'm so breathless. This is what we're about, we're not about this.

I made a speech to the AGU and I said, let's have a national debate on this subject. Let's ask the American public, what is it that you want, instead of telling them what they're going to get. And I encourage you to participate.

Okay. Oh, I'm really running long. Let me just summarize and say people are the most important asset we have. And as we undergo change, management at JPL and management at NASA, the NMO at JPL, we can't have anger between each other. As I come around today, and when Jack Dailey comes and when Wayne Littles comes, talk to us about the things that are causing these stresses so we could do it right. We've got to treat people with dignity. Just because you're a manager doesn't entitle you to brutalize anybody. Just because there's change everybody wants to feel good. Everybody has quality and we've got to step back and grill our people and communicate. And I see this is a very important parameter here at JPL.

So how do you fit in? I'd like you to be is the center of excellence in the world, best in the world in remote sensing. I define remote sensing as Planet Earth, the bodies in our solar systems, and the planets around stars.

I'd like you to be best in the world in robotic exploration of planetary bodies. This is my sense, my hope of where the mission of the Jet Propulsion Lab fits in. And if you can't be best in the sub-categories, drop out. Benchmark yourself and see how you are relative to other people in the world. And if you're not number one, say, "Here's my plan for being number one." After 3 or 4 years, if you can't get to number one, drop it. If you can't be best in the world with the talent and resources you have here, there are other people that could

do quality things too. So let's not try and duplicate things and not be best in the world. So that's my first point.

Second, do what you said you were going to do and hesitate to make a commitment until you understand. Let me give you an example. I spoke at the MEP at Wallops Island, the Management Executive Program. And a young man named Kevin is working on a thing called Theseus. It's going to take 343 kilos of payload to 27 kilometers for 50 hours in a remotely powered vehicle and I think he's talking about $10 million dollars for doing that. So they worked the program out; a scientist walks in and said he wants 400 kilograms. You know what Kevin said? No. You're getting 340 kilograms. That's what we agreed to, we had a contract, I'm not budging one ounce. So after you sign a contract, unless there's some Earth shattering need, just say no. Otherwise we'll be in the terrible cycle we've been in. So do what you've said you're going to do.

Cassini, Mars Pathfinder, Mars Surveyor, New Millennium spacecraft. We are going to cancel other things so we can get this started. Live up to the promise. I know you can. Have it in your guts and say it's a privilege to be working on this. I'm not going to be concerned about second order effects and I'm not going to let it make me dysfunctional.

Three. We're initiating a zero-base study. You don't know where you're going unless you know where you are. Wayne Littles, the Chief Engineer for NASA, is heading it up. Ed Stone is in charge for JPL. We want to review all our functions and all our programs and understand what each person is doing and why. We're going to question the requirements so we can avoid having things like this. Don't look upon this as another exercise. This is for big time real. We need you to do it so we could have the resources.

I just talked about the vision. This is $60,000 dollars every 3 months for one NASA program. A quarter of a million a year. It is 8% of your discretionary budget, Ed Stone. Think of what you could do with that. By the way, on the plane I read your annual report on the discretionary program. It's wonderful. You don't want to spend it on this, you want to spend it on that.

Things you want to look for? Employee to management ratio. At JPL, we're 5 to 1. Five employees per manager. We want 11 to one. It's been mandated by the President of the United States. NASA is going to get to 11 to 1. Now I understand everyone can't be a manager. This isn't a statement that the people who are not managers are not valuable. You could take your brilliance and apply it into a dual ladder. We need a dual ladder.

One of the things that we have to talk to JPL about is just because management is going to go in compression when it's healthy. I love it. I support the President. He's asking for the right thing. The dual ladder allows feedback.

It allows promotions and it allows people to do what they do best: technical things. So I view it as freeing up more brains to do the job we have. I know it's going to be frustrating, but the key to it is those in management cannot view other people without looking at their true value. You send signals not by what you say but by how you act. You have the best people in the world and it is essential to be treated that way. And if you're not being treated right don't put up with it.

I could go through a whole bunch of things. You'll hear about it. My next to the last point is we've got to remove the anger and the fear and be so proud of what we're doing. And we've got to work this together. You have the right leader, you have the right facilities, you are in the right place.

And finally, I'm going to ask each of you to make a contract with your boss. On one sheet of paper, write down how you relate to what you're doing. I went into the optics communications lab yesterday and talked to a brilliant young man. I was trying to understand what we would get back in terms of what's invested, in terms of kilobits per watt and how does this relate and where was the crossover point between k-band communications and optical communications? It's not his fault, but the management and the research area didn't help him understand what the challenge was and how optical communications fits into the picture. You can work on the most wonderful technology with passion, but if you don't know how it relates to the big picture, are you working on the right thing? So you need to have this contract with your boss about what the inputs are to you, what are the outputs, how do you relate, and what are the things that you're going to accomplish during the year? Make it very clear. When you have fuzzy contracts, there's room for frustration and anger and fear. And I hope I'm not directing it to you, this is a request. And you might want to think about it.

I'd like to close. I went a long time, but I had a lot to say and I don't have a chance to talk to you all the time. I'm deeply committed to the space program. In 1969, when Apollo 11 landed on July 20, I was at LaGuardia airport going to Harvard to take the bar exam. I missed the plane because I couldn't leave the TV set. When Neil Armstrong landed and stepped on the moon, I cried and I hugged people I didn't even know.

And I'd like to think 10 or 15 years from now, I could see a picture like that. I could see a base on an asteroid and I could shed a tear. Thank you very much.

NASA Administrator Daniel Goldin visited JPL Sept. 22 and addressed Lab personnel from von Kármán Auditorium. Following is a transcript of his remarks:

I am pleased to be here. I had a wonderful visit yesterday, and I was overwhelmed by the technology I saw. I was also overwhelmed by the capability and the brilliance of the people at the Jet Propulsion Laboratory, so I think it bodes some very, very positive things.

I'd like to introduce the people on this visit with me. Jeff Lawrence heads legislative affairs for NASA; he is the guy who got the bill through Congress. Mel Peterson, the NASA controller, is the fellow who helps us work all of our budget problems and works with the Congress very closely. He is absolutely crucial to what we are doing in Washington.

Let me talk a little bit about the process. I am asking NASA's chief scientist, Dr. France Córdova, to travel to each of the centers to spend two days before I get there. Then I arrive, and I spend two days, opening with an address to all the employees to give a sense of what I think are the issues, problems and directions we ought to go.

I state some basic principles for operation and then talk to the employees to get some feedback. I'm not just interested about the orbits of electrons around protons. I am interested in the issues that are hampering you from doing your job. There are things that I can do, and there are things that [JPL Director Dr.] Ed Stone can do, and there are things that neither of us can do.

There are some external forces that are causing tremendous stress. I am going to identify those stresses, so that you don't fret over them, because if you waste time fretting over external forces over which you have no control, it is a waste of time, a waste of energy, and it will sap your very strength.

Where we can help you with change, we can improve things, and we will do that. So it is very important, when we come around, to talk to us. Now, we don't have a big standing army, it is just Jeff and myself, and Mel will be around looking over your books, so it will be me, Jeff, [my assistant] Pam and Ed Stone.

After I make my visit, Jack Dailey—who is in charge of institutions at NASA—will come out, because we will have spoken to a broad cross section of scientists and engineers. Then I would like Jack to talk to the folks in the institutional areas: Finance, administration, contracting, small businesses, what have you. He will obtain feedback in general on what the Laboratory feels, and then we will take all that data, put it together and get back to you with an assessment of what we think. This process will take six months to a year. I want to emphasize it is not a two-day visit.

When I became administrator, I had a thorough plan on how I would manage the agency. The situation with the external forces, which I will talk about in a little while, just overtook me. Instead of doing all the things and having an internal focus like I intended, the last 2 1/2 years in Washington have been spent on myself and Jeff and hundreds of terrific people trying to save the space program.

Now, some people think that the issue is the space station. Let me assure you that the whole NASA space program is on the line. It wasn't a question of a vote on the space station; it is a question of, "Does America want to maintain a civil space program after the perception that, since the Russian competition had collapsed, there was no need for a space program?" That was the issue we worked on.

It is not guaranteed now, but at least we are at some point of quasi-stability, and before the next Congress convenes, we will spend a half year looking internally. Because if the employees don't understand the directions, forces, objectives, goals and vision, we will not be able to perform.

There is a certain level of dysfunctionality that I sense here at the Lab; with all the brilliance that I see, there is an underlying fear and anger that permeates things, causing the Lab to be somewhat dysfunctional. We would like to lance the wound and make sure that these dysfunctionalities won't cause you to go off in the wrong direction.

I also want to say that Ed Stone is outstanding. I am going to say this time and time again, but he has been giving out some very painful medicine, not because he wants to make people suffer, but because he recognizes the forces that are at play. He is not doing it to hurt anyone, but he is doing it because he believes it will make

JPL much more effective and assure a future.

If you asked how JPL was doing a year and a half ago—right after the Mars Observer failure—I would have said the chances of survival at JPL were 50/50. So it was not just the space station, and I want to also assure you [that there is] a good news side. Let me assure you that the Washington community, the executive branch and Congress looked to see what Ed was doing; [his actions] lent credibility in terms of what you did, and this had a major impact [on Congress]. I hope you will understand this message as we go through this.

I will repeat the same thing, because I am so proud of what Ed, the management team and the employees here have done. You turned around Cassini, you restructured it, and that saved it. There could have not been a Cassini, a Mars Pathfinder, a Mars Global Surveyor. All three of them are solidly in the budget. So, the basic message is that NASA and JPL have come through a very trying period, and we now have an opportunity to do incredible things; [we can] change the future of how people on this planet perceive themselves, as well as enhance the knowledge base of humankind.

I want to spend some time talking about these [external] forces, because when I talked to them here yesterday, many people didn't get a sense of it. Sometimes there is a tendency to be isolated from the world, and living in Washington is a little different than living in California.

There is a tendency also among folks who are involved intensely in science and technology to be isolated from the rest of the world, to not follow world events and to think that somehow America will never desert the space program. They think somehow some people in Washington will magically push knobs and levers and leave you alone to do what you do best. You cannot live that way anymore.

Modern communications have changed that. News travels at the speed of light. Unfortunately, the electronic media do not give you in-depth reporting, so perception becomes reality. If you don't read the scholarly journals, the in-depth reporting in the Wall Street Journal, the New York Times and some of the publications from the Counsel of Foreign Affairs, you won't have the sense [of what is really happening], and you will just react to things, and the public does that. So let me walk you through some of the issues I see that provide some context for why change must come, and why we will never go back.

JPL will never look the way it did. You will not build very many spacecraft that look like [Voyager]. You will not have a $3 billion Cassini. You must erase that from your minds. There are those who are concerned that when Cassini gets destaffed in 1997, what will the next big program be? There is none.

It will be a sum total of many small programs that will have to be fought for competitively, and they will have to be the best in the world. That doesn't mean that you are all going to lose your jobs, and JPL will go out of business. It just means that the environment will be different, and you will have to deal with it.

Let me deal with the most important [external force]: the collapse of the Soviet Union. The space program was founded in a time of violence. The United States had to make this enormous investment in terribly destructive weapons of war nuclear-tip missiles. It dominated the thought process of the day.

[When the Russians launched Sputnik,] it devastated America, because we thought we were the technological leaders of the world, and we thought the Russians were in the dark ages. You knew they made a few bombs and a few bullets, but what did they know about space? They launched Yuri Gagarin into space, and the technology, system design and engineering that went into that was a statement: "America really had concern and we were really behind."

So in this period of violence, many forces came together, and Kennedy needed a bold statement, and he looked at space. Some of his advisers didn't want him to go forward with Apollo. But he did.

Apollo was more than just putting a human being on the moon. Apollo was a unifying vision that said America would spend whatever it took to demonstrate to the world that we could lob bigger packages into space, with the implication that we could launch bigger weapons into space.

Through the whole space program—the Mariners that you did here, the Surveyors or the astrophysical things that we did—we demonstrated to the world that America was technically superior, and those countries in the middle would then come into the western bloc, and we could defeat the evil empire.

That's what the space program was about during those great days, and everyone fondly wanted to go back to

those days. During the 25th anniversary of Apollo, I kept hearing, "Mr. Goldin, why can't we do what we did in the '60s?" Let me tell you why. We spent 4 1/2 percent of the national budget on space during Apollo. Now we are spending less than 1 percent. That is a big difference.

We were concerned about the very survival of America. We use to have bomb attacks in school. You know, flash attack, hop under the desk to protect yourself from flying objects. So, the nation had a real purpose for the space program; it was part of the national defense. If you wanted to start a new program, boy, did you get it fast. There was never a question about it. Yes, there was some tension, but it was a different time, and we are never going back unless we have another condition like that.

So, it is very easy for the press, [and other] people to criticize the NASA work force and say they don't have the vision we had back then. We don't have the driving force we had back then—survival. That changed everything. This, I think, is one of the key factors, because all of society is undergoing change.

People try to find culprits. The budget is much less, the conditions are much different, yet there is a sense that the people who work on the space program are less than competent, that they are associated with waste and failure. If you read the press for the last three or four years, [it mentions] the troubled space agency. [The press] took two or three events we have had in the last five years, when we've had some 55-60 successful launches.

We've just had a few failures, and the focus was on the failures because America needed something to grab onto. When there is uncertainty, you look for someone to blame.

I think this caused part of the frustration and anger, because we are now getting a lot more oversight. If there is perception of waste, the American public is going to want to understand, and that is where the oversight comes from. It doesn't come from Ed Stone wimping out and telling the General Accounting Office or the Inspector General they can't come in here. It would be absolutely wrong, if the American public wants to have studies of what we are doing and do all sorts of things to understand; we have to welcome them with open arms. Your leader is not wimping out. He is doing the right thing.

By the way, this change happened with the speed of light. The Berlin Wall came down in 1989, and in '91 Gorbachev dissolved the Soviet Union. In '91, Norm Augustine headed a panel doing a study that started in '90 to see where the future of the space program would go.

In the same year, 1991, Augustine's panel called for a 10-percent increase in the NASA budget, per year, over the next 10 years. That said that the NASA budget would double, close to $30 billion by the end the decade. So, it happened at the speed of light. But, who knew that Gorbachev was going to dissolve the Soviet Union when they were writing the Augustine report, which talked about science being the most important thing we do?

We [were] going to have all these scientific missions, we [were] going to have new starts. There [was] a feeling of euphoria at JPL and NASA. We had the solar exploration initiative, and if we go to Mars, we would have all these precursor missions at JPL that were robotic in nature. We [were] going to have new launch systems; the solar exploration initiative was only a half-trillion dollars.

A half-trillion dollars—now there were some optimists who thought it could only be done for $250 billion, or a quarter of a trillion. It seems funny now, but it wasn't funny in 1991. When President Bush announced it, he was dead serious, because we had to show the world that America could be superior to any other country.

I was appointed administrator on April 1, 1992, and within a few months, I went to Russia and the Ukraine. They took me into the weapons factory, the one I spent the major portion of my career targeting. Now think about that. I walked into the SS18 factory, the most destructive weapon in the world. Here I was walking into the factory, and they showed me the welding machines and if I asked a question about this, they would show me that. I mean, "what do you want to see?"

So, when all of a sudden Congress is screaming to cut NASA's budget—or perhaps eliminate it—they were not doing it because they disliked NASA or what you've done. You have done brilliant work. The issue that was driving the members of Congress is that the world had changed. The reason for a space program was to beat the Russians—just pick up some of the literature and read it. People said, "No, the Soviet Union has come apart, why do we need it?"

Now the focus of attention was a space station, but let me assure you it was broader than that. [Dr. Stone] probably lives in Washington and cleans his laundry in Los Angeles. He was back in Washington all the time, trying to save your program. So, it was a broad issue. So the Soviet Union coming apart was a big deal.

A second issue is the national debt. The Vietnam War changed America completely, and when it started, our industrial output was enormous, our manufactured goods were sold worldwide, our balance of trade was super high, and then something funny happened. All of a sudden our balance of trade went negative, and instead of driving cars built by General Motors and Ford, ... just take a look at your parking lot today. You can't even buy a VCR manufactured in this country. So, as result, Americans went on a buying spree. A whole psychology changes as a result of the things that happened in Vietnam, and a buildup that came after that. So we had a huge national debt.

A major reason for the national debt—not just the economic reasons—was that we had to have a defense budget that was beyond belief. The United States provided the [world's] nuclear umbrella. When the president of the United States showed up at an international meeting, everybody stood up, because they were under the American nuclear umbrella.

There was just an article after the G7 Summit, and they said that President Clinton did not get the same respect. It wasn't that President Clinton isn't a great president. It was that the nuclear umbrella isn't such a strong issue, and now there is a lot of bump and shove economically. This is disconcerting and people want go back to the good old days, but the good old days of the nuclear umbrella aren't necessarily there.

So, here we have this huge national debt. We had the budget cap. That was the response a year ago—Congress capped that budget. It is locked at $1.5 trillion a year. So, this is an issue. [People] come to me and say, damn, we've got to have that program. [I answer] It's not under my control—there is a cap on the U.S. budget.

There are enormous pressures. We have to provide housing for people. There are people starving. The economy is in trouble. These issues must be dealt with. The entitlement programs are growing by leaps and bounds, because the American public wants them. Half of the U.S. budget is entitlements, $750 billion a year. A quarter of a billion dollars goes to paying off the debt; now we are at a trillion dollars a year. So, five-sixths of the federal budget is really capped, with some [items], like entitlements, growing. This is why there is the health-care debate.

So with the cap at $1.5 trillion a year, you deal with the domestic discretionary spending. Guess where NASA is? In domestic discretionary spending, we have veterans who lost their limbs in war. Could you turn them away? That budget goes up at 8 percent a year. When you really get down to it, maybe about a $100 billion a year is what Congress operates on, and tries to deal with all these pressures. So, it is not that they are against NASA, or what we are doing. It's saying one message: the NASA budget has to come down.

When I took over as administrator, we had this momentum model for the budget. I kept telling people we can't go on like this, and they thought I was a bad guy. I love everything in space. I love everything I see, but the reality is these issues playing here. So, if someone at JPL wants to start a Pluto Fast Flyby, where does the money come from? We've got to cancel something. The budget at NASA is going to come down, for the next five to 10 years, no matter who is in the White House.

We have a weak economy, [and] it is hard for America. It's a lot better today than it was two years ago. But it still does not have the robust stance that it had in the good times. I have a house in Southern California, but I just can't sell it. So, when there is a weak economy, there is a perception about relevance in the space program. Again, we can't just start things unless we can get more relevant to the American people.

The science community is not our customer. NASA headquarters is not your customer. The American people are your customers, and we have done a rotten job in communicating with the American people. We do a terrific job in communicating with the highly educated, but not with the broad population of America. So, is it any wonder that, with all these forces, the NASA budget is having the problems that it does? There is a mood in the country to downsize and change government. The 1992 election sent that message loud and clear, and if you think reinventing government is toy or a joke, come to Washington and see how real it is.

Mike Mott, who is a chief of staff at NASA, went to the White House and met with deputies from all the agen-

cies in all the departments of government. If you think NASA is undergoing tremendous change and stress, you should see what's going on in the other agencies. The federal government is going to be at its smallest level, I think, in two or three decades. So, when Ed Stone is trying to downsize JPL, he is taking presidential directive, and the president is taking direction from the people of the United States. So, there is not any move afoot to cause pain and suffering, but the American people, our customer, want government to be smaller.

We believe in what we are doing, but we will have to earn every last dollar. [If] we want to start a new program, we must be more efficient, or we had better cancel something. By the way, if we just want to stay where we are, we will have to do that in any case because, at the very best, our budget will be constant without correcting for inflation. We will lose about 3 percent a year.

This is a reality, but it is not that you've done a bad job; you've done a brilliant job. You've been part of some of the most important things in history. But now [that] change is coming, how are we going to deal with those changes? I talked about rising entitlement costs, and now there is one other factor, which I call the changing face of Congress.

When Jeff [Lawrence] first took his job—he is a political appointee and works for President Clinton, just like I do—I said Jeff, could you give me a histogram and tell me the distribution of votes we have in the Congress based upon years of tenure. It was very interesting. Those who support the space program had from 12 to 20 or 30 years' tenure in the Congress. They were part of the Kennedy buildup. They understood more than just the competition aspect. They were an integral part of the program, they shared our successes and cried with us when we had our failures, but they understood. The members who were in Congress between six and 12 years were lukewarm for the program, and the members between zero and six years generally voted against the program.

Now it gets worse. In the election of '92, more than 100 members of the House of Representatives turned over. The projection for '94 is that another 100 people are going to turn over. These are fresh new faces, people who are coming in because the incumbents lost, because America wants change, smaller government, a government more responsive and more relevant, that is going to deal with the issues of the country. They are not going to deal with tradition. They want change. That's what America wants.

A number of women has been elected to Congress, which I think is beautiful and wonderful. The size of the black caucus is increasing. The size of the Hispanic caucus is increasing. Congress is more representative of what America looks like. [But] many women and many minorities don't feel the space program has been responsive to all of America.

The image of the space program is mission control at JPL or in Houston. Generally, what you see are white males with white short sleeve shirts, and—this was a few decades ago—crew cuts. I am not saying that being a white male is bad, but what I am saying is if America owns this program and they are our customer, the National Academy of Sciences is not our customer. If this is their program, they darn well better feel that this program belongs to all Americans, and the program looks just like America.

There is another stress at JPL, and now crazy Goldin is at it again: Why is he forcing small disadvantaged business down our throats? Why do I call for diversity? This is America's program, and by God, every single American who wants to participate in it, and has the skills, will not have gender or culture stop their ability to get in or get promoted.

Now, I don't think there is any malicious segregation, but there is a tendency on the part of my generation to look at people and form some image of what they ought to be. If we re-create the management structure in the image of the structure of 25 years ago, it is a self-fulfilling prophecy—white, middle-aged males.

Don't be angry; participate. It is crucial. When we have a launch, or when those comets slammed into Jupiter, [there were] billions of people watching. Now if billions of people watch only white middle-aged males, it's not right. I'm not saying that we take out only the white middle-aged males and replace them, I am saying that you have to have a diverse work force. [To not do so] is immoral, wrong, and not as effective.

So these are the forces at play. You could get angry about them. Or you can say, by God, the American people have decided what they want out of their space program. We are not going to tell them what *we* want, they are going to

tell us what *they* want.

I talked to people about this unifying vision, what the next major mission might be. Someone said, "No, you can't have open discussion, we've got to wait for the right time and then tell the American people what they are going to get." You understand. This is the issue. This is how we have to deal with the space program.

So, what is the impact of all the things we have talked about? First, there were calls in Congress to cancel the space station. Some people thought that if we can get the space station canceled, boy, we will have the money to do the things we want to do. I am sure that nobody at JPL tried to get the space station canceled.

The American public, whether you believe it or not, wants humans in space. There are our customers. They want a balanced space program. They want to see humans in space, but they don't want to spend all the money on it. They are not interested in people making their careers doing wonderful things, exploring issues, understanding the science. They want a program that is relevant to them, and they also want to share the excitement of the human experience.

So if anyone in this room, anyone at JPL, anyone in a science community believes that by canceling the space station they will get a better set of situations here, they are wrong. Again, that is immoral. By what right should you protect your jobs when the program belongs to the American public, and we have to be responsive to them?

They don't owe you anything. They just want to get things that can inspire them. To have their children want to enjoy math and science. They want to understand creation in the broader sense, the crossover between cosmology and theology. They want to understand how the solar system formed. This is the nourishment of life, what is important. They want to share it through the human experience.

People think that when you cancel one thing to protect jobs, it will backfire and will be a disaster. So what we have strived to do is have a more balanced program, because the human space-flight account took up 50 percent. We now have it down to about 38 percent, and I hope that we can even get it lower. We have increased the science portion, because, I think, again, that is what the American people wanted.

In town hall meetings, that is what they told us. There was a call for cancellation, and then it wasn't helped very much because we had the Hubble problem. We had the Challenger [disaster] and [stories about] the troubled space agency. One evening at a dinner party in my house, I got a call that we had lost Mars Observer. So, I said let's do what we have to do, let's call in the press and be very open with them and say that we have had a failure.

Within eight hours, we lost a weather satellite. Then the Defense Department launched a classified spacecraft for a billion and a half that went into the drink. Do you know what the first headline was? "NASA loses another satellite."

You see, the public identifies space with NASA. We are an unbelievable inspiration to them, so they give us credit for or they beat us up for anything that happens in space. But it is wonderful, and I am thrilled that that happened, because it indicates that America wants a space program. But those failures did not help our condition. When you have a failure, the most important thing you say is, hey, we had a failure. You don't make excuses: "It was headquarters' fault."

I had a discussion last night with a woman who spoke passionately, asking "Why are you ruining the reputation of this Lab?" I said, the Lab is accountable and responsible for Mars Observer; it failed. Stand up, and say it failed. If there was something wrong, you should have called it out and said we shouldn't have done it. If we at headquarters or anyone else forces a contract down your throat that's stupid, just say no. I'm serious about that. You better not take it, and then when a problem occurs, say, "I have an excuse." No excuses are accepted. This is the subject of accountability and responsibility.

We got a wake-up call a year ago. The space program passed by one vote. Notice I didn't say the space station. The space program passed by one vote. There were calls to cancel Cassini, to not start Mars Global Surveyor. But we communicated with the American people and Congress, and I am happy to say that in 1995 we won by two to one in the House and Senate. I hope today that they will actually get the bill that the Senate ratified. It is a very healthy bill.

What are the solutions? We have two choices. Everyone [here] votes. You vote with what you do around the

water cooler. You vote with what you say to your fellow employees, you vote with how you feel. You could say, "Hell no, I won't go; I want to hold on to the old program." Or you could choose a path of change, and roll with the punches.

When auditors come in, you can say, "God bless you, we need you, we love you, we will give you everything we've got." I say that half-seriously and half in jest. Because if you tell auditors they are not welcome, how do you think they are going to feel? Do they think you are trying to hide something? I think so. They are doing their jobs. They have been asked by the executive branch and by Congress to review what you are doing.

Let us say, across NASA—and I include myself when I say it—our record of overruns is beyond belief. A record of not delivering on our promises is very open. There is a sense that all we have to do is get it working and launch and all is forgiven, hoping that it will never occur again.

The American public wants a lot more from NASA. So we will choose a path of change, learn to live with the declining budget and make the most of it. We must rebalance the program between technology and science, big and small, humans and robots. We will make room for new starts by being more efficient, drastically changing how we operate, canceling sick chickens and prioritizing. Darwin is going to reign supreme at the NASA of the future; survival of the fittest is what it is going to take.

I believe it will make the program stronger. No longer will we allow mediocrity. Now, I don't think mediocrity comes from the people. We in management have given you outdated systems. You don't fail, we fail you. The systems we had in place were designed for the period when we were going to beat the Russians, and getting things launched—not cost—was most important. But in the new operating room, this is no longer acceptable.

Again, I understand your frustration. But don't take it as a sign that you have failed, especially at JPL, where you have some of the most brilliant people in the world. Your capability is second to none. But again, when the country is in a negative mood, the employees generally get criticized and you take it personally. I am the administrator, and I am telling you you are outstanding. I see what you have done. It is wonderful.

I believe that we are on the right path, that the changes here have happened so fast that no one even saw them coming. In November 1992 the change occurred when Americans went to the polls. The president is in the process of making this change happen. So, we have the best support in decades from the White House. The president is engaged. He spends an enormous amount of time on this program. The vice president is engaged. I don't know how many phone calls he has made. The president and vice president have invited the leaders of Congress to the White House. They involve the whole U.S. government. We have a priority that is way at the top.

During the Apollo celebration, I was in the Oval Office with the president and three great Americans—Michael Collins, Buzz Aldrin and Neil Armstrong. The president couldn't stop talking about how proud he was of the tremendous support for the space program and the vote that we had. The Congress gave us a two to one margin; the people at the Office of Management and Budget are engaged. They know what you are doing. There is tremendous excitement.

I believe the American people's perception is changing. We are no longer called "the troubled space agency" because of what you have done to change. Even though there is some concern, you have sent the right signals. You wouldn't have Cassini, Mars Pathfinder and Mars Global Surveyor if you didn't change. So you were the ones who really did it. Ed Stone was the spokesperson, but you actually did it.

[I would like to talk about] the generic vision for NASA, a new operating mode, seven basic operating principles, people issues, and how JPL fits in.

First, let me say, if we perform and execute with the talent pool we have, I believe we have an unbelievably bright and promising future, but one with no security, because we will have to earn it. We are on a path toward consensus, and 10 years from now NASA will look very different.

First, we are much too focused on operational and institutional issues. We have much too large a fraction of our budget dedicated to that. Wes Huntress' budget—which is Space Science, and that is where you live—has about one-third of its budget in operation. What a waste.

Why should we have people sitting at consoles in 1994, when we have the wonderful technology I saw [here on

Lab] just yesterday? You have the technology to almost eliminate these operational jobs. I would like to see you launch a spacecraft that is hands-off. Why do we need people even talking to a spacecraft when it is on a 10-year voyage?

I took a look at some of these frequency standards. It boggles the mind. In the Microdevices Laboratory, I saw a camera that does all the mission planning for you. You don't need a team of mission planners. You can look at the planet and pick out all the key features automatically—no people involved. So, why not take that money and spend it on development?

In the '60s, NASA was a development agency, doing bold, exciting technology, breaking technology barriers. Now take a look at our work force; we have a whole bunch of people doing things that could put you to sleep. I am not saying that everyone at the Lab is doing operations or institutions, but let me give you some evidence.

The Mars Global Surveyor was supposed to be faster, better and cheaper. *[Drops stack of operations manuals on table.]* Gravity works. Everyone thought they were doing the right thing. This is not the way to do things. There is no excuse for all this paper in that package.

[Another] package is the famous JPL procurement forms manual. Now, do you want to spend your remaining days in the space program dealing with garbage like this? Who has the courage to say that this is unnecessary? This is not what we are about. We are about leaving Earth. We are not about paper.

There is a group down in the South who had 200 people trying to reduce touch labor. Guess how many people in touch labor there were? Two-hundred. I want to cry. This is not what we are about. Yet, when I ask for the budget to be cut, I'm told safety will be impacted on the space shuttle and destroy liability on these other flights. I think that is a bunch of crap.

Let me give you another one. This is not from JPL, but it could be. Here we have a quarterly financial report, Form 533. There are more work codes in this than the number of people working on the job. Nobody read this report. Then the Congress ... is investigating NASA because the contractors are not coming clean on overruns. But everyone says "hey, I did my job, I'm safe. I spent $60,000 on this report. It is all documented." [But] it is worth the powder to blow it to hell.

Now, this does not have anything to do with shuttle safety or quality of a Voyager spacecraft. This is about denuding forests. So now this operational and institutional stuff has to go. I submit that you could eliminate 1,000 jobs here and convert those jobs into going to Pluto and the sun, and into building interferometers that might actually take a picture of a planet around a star. Now, wouldn't that be more fun than being angry and frustrated every night?

This is the issue, and this has nothing to do with your brilliance or dedication. This has to do with the fact that no one is willing to question the requirements under which we operate. You must have some courage—remember "question authority"?—you've got to do it. And if you are afraid, you don't belong here.

I am being very harsh and severe because I am worried about the future of the space program. And JPL is not about this stuff. We are going to have a new technology program; it's called the New Millennium spacecraft. Ed Stone and I had dinner two months ago, and I said to Ed, "Why isn't JPL the best in the world in quantitative science and large astrophysics?" We went through it and we are not investing.

We have a Catch-22. You build spacecraft and the program manager says, "the program is so big and so long." You go to the program manager with a new widget, and the program manager says, "I can't fly that because it didn't get tested in space." You say, "How will it be tested in space if you don't fly it?"

We will break out of that, because we will make an investment. Now I am going way out on a limb. This program isn't approved. But I am absolutely committed to carrying it forward, and if we do it by the year 2000, we can launch 10 to 15 spacecraft a year. Not a decade. A year. Won't that change the face of the space program?

And another thing is that we need more experimental craft. When we [previously] built [spacecraft] it cost a lot of money, because we had to check it out on the ground, we had to do a lot of analysis. Now, what if we built some experimental craft that test technology, and launch these things all the time? That is what you are going to do. Talk to the folks over in the Microdevices Laboratory. They have an unbelievable concept. So we will get away from this constraining Catch-22, and we will have experimental programs, not just for spacecraft, but for launch vehicles.

I made a commitment to Ed Stone. If we want to have 10 to 15 launches a year, you can't pay $20 million to $60 million a launch. We are going to try to get you a launch vehicle on the order of $5 million to $10 million.

How are we going to do it? In testifying before the Congress, the new launch vehicle is the highest priority. The next highest priority is a New Millennium spacecraft. So we are going to cancel something. Peer review and Darwin are going to have reign supreme.

[There will be] changes in the way the agency will look. We won't have vast control centers with hundreds of people doing these things. We will have people in the development stage and in the experimental stage. That's why we want JPL. We don't want a production facility here. We want your brilliant minds to go to the next frontier. Peer review dominates. So, let us look at the criteria for the new set of peer reviews. By the way, if you have better ideas, we need the feedback.

First, relevance, not survival, dominates. Will it benefit America? Will it inspire young people? Will it provide a new level of knowledge to humankind? Will it provide technologies to spur new industries? Will it involve America? These are the questions of relevance.

Second, cooperation, not just competition. The world has changed. The weapons builder walked into the former enemy's weapons labs. So, we are going to have to work with other countries, and I think JPL is right on target. You are talking to the Russians about a program called Mars Together.

Why should we have common infrastructure? If we have to put up the same things as the Russians for infrastructure, we have less money for designing spacecraft. We will also have to work closer with other government agencies and JPL. We are going to have to help you.

There were some complaints yesterday that NASA is causing you to have an at-arms-length relationship with industry. We need you to get closer to industry. You could spur economic development in this nation beyond belief, if we empowered you to do that, and we will have to figure out ways of doing that.

Revolution, not just evolution. Relevance has been overtaken by technology, so we are going to have revolutionary new technology, and I will give you an example. After Ed and I had dinner a few months ago, within three weeks he walked into my office and said "Here is the replacement to the MESUR mission." Keep in mind that two years ago, JPL said the MESUR mission would cost $2 million, and we would have landers, retrolanding on the planet or using parachutes.

He showed me a one-pound spacecraft with the payload the size of my fist. Something that might be built for hundreds of thousands, and you drop them out of the [Mars Global] Surveyor spacecraft all over the planet. You could make meteorological measurements, and yesterday, they said they could even make seismological measurements. So you could literally reduce the price of that mission with technology as an enabler, and really get the data that we wanted.

So, MESUR would have provided a lot of security and a lot of jobs, but the new approach is going to open up science on Mars and on other planets that have an atmosphere. Technology is an enabler, it is crucial, but the problem was that we at NASA did not make an adequate technology investment at JPL, and with Ed's leadership we are going to try and change that. We are going to fight that battle this year.

Less is more. Remember, I said the budget is coming down. Just take a look at what you are doing on Pathfinder. That is 1/20th the cost of Viking. You are doing a lot of good science. It is a very valuable mission. The shuttle just landed. The people at NASA's Johnson Space Center built this thing called Safer, a jet pack that hooks onto the life support system. For $7 million. The prior jet pack was $100 million. This does the job in 90 pounds [where before] it took 400 pounds. So, less is more.

Diversity in people, places and ideas is something that I will not yield on. I believe you will not yield on it either. When your program comes up for peer review, if it has not touched a cross section of America, it will be marked down. Companies are told [this] when they bid on programs. I worked with Wes Huntress to make sure the Discovery proposal called for diversity.

Are you involving a cross section of America in the program? Not people who aren't qualified, but people who have the right degrees and the right knowledge. But we have a tendency to say, "show me your experience and then I'll see if you get the job." Now, how in the world will you get the job if you don't have all the experi-

ence, but you have the human potential? You have a demonstrated ability to do things, maybe not in those categories. It is crucial—I can't emphasize this point strongly enough—that I want you to understand the most magnificent scientific project may not make it unless you are cognizant of this. There are some outstanding minority[-owned] businesses out there. I've worked with them.

When I was at TRW I was asked, "How can you involve the small disadvantaged business and build quality hardware?" I said that they have built quality hardware, and all we have to do is teach them NASA soldering and some of the flight procedures. There was a revolution in manufacturing, and [it was] said that they were going to destroy programs. This company delivered on time, on budget, with equal or better quality. Not if they were just getting a free reign, and if they don't perform, you can't contract.

But you've got to change the way you look at people and things. We cannot go on this way in America in terms of gender and culture. There are people in North Dakota who have a wonderful aerospace institute there, but they are locked out of the space program. Most of the activity in the space program takes place in California, Alabama, Florida and Texas. We have to open up our minds to new ideas and not lock them out because they are not part of the "old boys' network."

Think about it. I'm know I am coming on real heavy, but most of us are comfortable with those we know, and don't give those we don't know credibility for having a capability to do things. The U.S. Congress doesn't look lightly on this "old boys' network," and we've got to eliminate it from our thinking.

Outreach. In our town hall meetings and talks with members of Congress, I am getting universal feedback that NASA is not communicating. How many people wrote for My Weekly Reader? I did. How many people wrote an editorial for their hometown newspaper? To explain to them the beauty of what you are doing, to share your experience. But how many wrote in scientific journals? I bet almost every hand could go up.

This is not the job of the administrator or the public affairs office. I told public affairs "not a nickel for propaganda from NASA." The outreach comes from everyone in this room, and if you don't do it, it is not going to happen. It is like water on the parched desert when you do these things. You'll improve the quality of people's lives by talking about the beauty of what you do.

My final principle is do what you say you promise to do. Don't rush into a job, don't have a job where you haven't worked out the requirements in advance. Don't pick a budget or a funding profile that you don't understand. Say "I'm not ready; if you want to force it down my throat, go some other place." The new rule is that you've got to do what you say you are going do.

Clearly, if you are going through a scientific frontier and have a problem, you probably can't anticipate that. Of course we are going to deal with it. But I am not talking about that; I am talking about broken promises. I am talking about overruns due to mismanagement—not by people but by systems.

The Congress is very serious about us doing what we say we are going to do, and we can't constantly slip launch dates and costs, and change what we said we would do. That is probably more important that anything I've said.

I spoke to your Cassini program manager. There is a little problem here, because I talk about taking risks, but let me tell you, we cannot afford to have Cassini fail. Now, I would love to tell you that there is lots of room for margin. I also want you to know when the debate started, I wanted to cancel Cassini, because I thought it was much too big, much too complicated, it was putting all our eggs in one basket. If the launch vehicle failed—and we are [using a] relatively new launch vehicle—all the beauty of the mission would go away.

If the payload failed, we would not have the hope of the country, and $3 billion is a lot of money. So, everyone wanted to do it, then there was an outcry; the scientific community wants it. Our international partner said to the United States, "you've got to do what you say you are going to do." That is why we decided we would go for it. Because when America gives its word, we've got to live by it.

I am expecting JPL, which desperately wanted this program, to perform, and I am holding you accountable for the launch vehicle and the payload—no excuses. You had better understand the launch vehicle now. You had an opportunity to go on the shuttle, but you selected the Titan IV. So you can't go and say "Hey, everything is OK, [but] the Titan IV failed."

I am setting the rules of the game right up front. If you have to understand every resistor in every European payload, and have [the Europeans] understand every resistor on our payloads, go ahead and do it, but do it now. Don't set yourself up for an excuse.

Now, I am being very tough. But I want to tell you, I believe I understand the sense of the U. S. Congress and the American people. All you have to do is listen to a few hearings that I was testifying in, and see what was dished out in terms of the intensity of those hearings. I put my hand on the Bible and I said we are going to launch Cassini, but you [at JPL] are accountable. The program manager here is accountable and responsible. Ed Stone is accountable and responsible.

I am saying this up front so there is no question later on. Not because I want a failure, but because I would like you to put in the intensity and do what is right now.

I am [also] concerned about the Mars Pathfinder. Some young man said yesterday "Mr. Goldin, you can't expect us to guarantee success; it is [being built with] class-C parts." Hey, they are spending $171 million, plus $60 million for a launch. [That is] a quarter of a billion dollars. Wake up and smell the coffee.

We don't have 10, 15 launches a year. We have already failed on Mars; now, I wish it was different, but we are going to live under the eye of the microscope, and I say we, because I join with you. We are going to have to produce on those three programs.

So, I want you to understand this concept of risk. Take the time now and don't set yourself up to make excuses later. Do what you need to do to make a parachute system work. I understand it is a few months behind schedule. Don't take shortcuts. If you've got a problem, say it, and if you overrun more than 15 percent, we cancel it. I want you to be sure that you understand the rules. This is how Darwin works.

We are going to explore the solar system in the universe as we have never explored it. We are going to have flyby missions, orbiters, landers and sample returns.

I was just at the moon rock [display] in Houston. How much room do you have [on spacecraft] for rocks from asteroids and comets, and how much room do you have for rocks from Titan, and some of the other moons from the other planets? This is what you are about. You are not about this. *[Points to stack of procurement manuals.]*

By the year 2000, you ought to be launching these missions. I believe you could have a sample back here by 2003 or 2004. Maybe it won't be hundreds of pounds, maybe it will be 100 grams. Imagine what you could learn. You could do it.

Now, if you want to see the face of the future, go over to the Microdevices Laboratory. They have a spacecraft on a chip. It is literally the size of a silver dollar, and you just drop a whole bunch of these things through the atmosphere, when you could make magnetic measurements. We are going to do whatever it takes to get you the resources to do that.

I also believe that astronomy and astrophysics are good, but not outstanding. There is no reason that we shouldn't be able to image with real resolution. They showed me something yesterday and said "Dan, we could build this interferometer, and we could get one pixel and image a planet. Before that we could infer that planets exist around stars by looking at the stars' orbit. I said "No, I want 25 kilometers' resolution." But could you imagine, if we did it.

Now let me tell you what you've got here, if you don't know about it. You are among the world's leaders in optics. ... We could make cheap reflectors, ultra lightweight, ultra low cost, and it's right within our fingertips. Maybe what we have to do, Ed, is make this part of the New Millennium Spacecraft and open the definition of planetary and say that means to do real relative planetology.

Again, I know of no better place in the world that has the capabilities to do this than JPL. I am not talking about 2030 and 2040; these things could happen in 10, 15 years. This is within your grasp if you decide, "This is not going to dominate my thought process, but I am going to convert that money into doing the things" I just stated.

You are flying circuit densities that are decades old on every spacecraft you have now, and on Cassini. Take a

look at what's available now, look at the software. You are flying aluminum; why not injection molded bodies? How about expert systems in these new cameras? These are the things you've got to do.

I believe JPL is going to be the catalyst that changes the whole NASA space program. The whole world's space program. The only way you will do it is to decide you are going to get over anger and frustration and fear, and you are going to say what a privilege it is to work here. Yes, the standard of living will go down. But the standard of living of America is going down.

The standard of living can't go up at JPL while it is coming down in America, and I know that there has been a salary freeze, that we have had compression in the management ranks, that there are restrictions on travel. But what a privilege to be able to work on these things. I get goose bumps just thinking about it. You can change the way the human species looks at itself, and you can do it within your lifetime. This is what I see as a vision of what we can do.

Let me say further that we have four things to do before we can send humans into space again on a major mission. We have to figure how they can live and work safely in space. There are some unbelievable problems to overcome. What happens when cosmic particles rip apart the genetic code? How can we responsibly send anyone out of the protection of the Earth's magnetic field into space before we do this? How do we screen people so they won't develop cancer or heart disease on the trip?

We are going to be on the cutting edge of genetic engineering. Now, we have to be careful not to violate the rules of ethics. But we have some incredible things, including chemical and genetic surgery, because you can't afford to take an operating room on a spacecraft. This is what the space station is about. It's not about jobs. It's not about maintaining stability. Also, the space station is a cultural testbed. We are going to learn with Russia, and not point weapons at them.

Third, we've got to do these missions not for a half trillion, but for $25 billion, and not in 30 years, but in eight years. The technology, to a large degree, could come from here. The most successful exploration missions have been living off the land. You are working on a concept here to convert the Martian atmosphere into breathing gases and fuel to return to Earth. How about in 2002 we [have] a breathing gas station, a fuel station and a robotic station on Mars to see if it works there?

You can do it for a half billion, but do it for $50 million and $100 million. Why not? You could allow the human species to leave earth orbit. Everyone is tired of the shuttle going up and down. It is boring. Who wants to spend $4 billion a year to go up and down? We've got to get out of Earth orbit.

And finally, the fourth condition is precursor missions. One, we could explore the asteroids and the comets. We could put a space station on an asteroid. Everyone is interested because of what [may] happen if one bumps into the Earth. Look what happened with [Shoemaker-Levy at] Jupiter.

So we have to have an exploration mission robotically to the asteroids to find out their composition. Do they have water content? Could we convert the water into fuels and breathing gases? Are there hydrocarbons or minerals there? What should we do with them?

Another possibility is to go back to the moon and do a lot of scientific research, and perhaps some commercial activity.

We could go to Mars, to find if life exists. You are taking the first step with Pathfinder. I made a speech to the American Geophysical Union and said "Let's have a national debate on this subject. Let's ask the American public what is it they want instead of telling them what they are going to get." I encourage you to participate.

Let me just summarize here that people are the most important asset we have. As we undergo change, management at JPL and NASA can't have anger between each other. As I come around today, when Jack Dailey and [NASA chief engineer] Wayne Littles come, talk to us about the things that are causing these stresses.

We've got to treat people with dignity. Just because you are a manager doesn't entitle you to brutalize anybody. Everybody has quality, and we've got to step back from brutal treatment of people. We've got to communicate. I see this as a parameter here at JPL.

So how do you fit in? I would like you to be the center of excellence in the world in remote sensing. Now, I define remote sensing as the planet Earth, the bodies in our solar system, and planets around stars. I would

like you to be best in the world in the robotic exploration of planetary bodies. This is my sense, this is my hope of where the mission for JPL fits in.

If you can't be best in the subcategories, drop out. Benchmark yourself and see how you are, relative to other people in the world. If you are not number one, say "Here is my plan for being number one." If after three or four years you can't get to number one, drop it. So, let's not try to duplicate things and not be best in the world.

Second, do what you said you are going to do, and hesitate to make a commitment until you understand. Let me give you an example.

I spoke at a management executive program, and a young man said he was working on his thesis. He was going to take 340 kilograms of payload to 27 kilometers for 50 hours, and I think he is talking about $10 million for doing it. So they work the program out, 340 kilograms, then a scientist walks in and says "I want 400 kilograms. I need to do these things." The young man said, "No. You are getting 340 kilograms, that is what we agreed to. We had a contract. I am not budging one ounce." So, after you sign a contract, unless there is some earth-shattering need, just say no. Otherwise we will be in this terrible cycle we have been in.

So do what you said you are going to do: Cassini, Mars Pathfinder, Mars Global Surveyor, New Millennium Spacecraft. We are going to cancel other things so we can get this started. Live up to the promise. I know you can. But have enough guts to say, "It is a privilege to be working on this. I am not going to be concerned about second-order effects and I am not going to let it make me dysfunctional."

Three, we are initiating a zero-based study. You don't know where you are going unless you know where you are. Wayne Littles is the chief engineer from NASA heading it up and Ed Stone is in charge for JPL. We want to review all our functions and programs, and understand what each person is doing and why. Then we are going to request the requirements so we can avoid having things like this.

Don't look upon this as another exercise. This is for real, big time. We need you to do it, so we could have the resources to do what I just talked about. This is $60,000 every three months for one NASA program, a quarter of a million a year. It is 10 percent of your discretionary budget; Ed Stone, 8 percent. Think of what you could do with that. On the plane, I read your annual report on the discretionary programs—it is wonderful.

The things you want to look for are management and employee to manager ratio. At JPL, you are five employees per manager. We want 11-to-1. It has been mandated by the president of the United States. NASA is going to get to 11-to-1.

Now, I understand that everyone can't be a manager. It isn't a statement that the people who are not managers are not valuable. You can take your brilliance and apply it in dual ladder. We need a dual ladder. One of the things we have to talk to JPL about is that management is going to [be compressed], which is healthy.

I love it, I support the president. He is asking for the right thing that dual ladder allows. Feedback allows promotions, and it allows people to do what they do best—technical things. So I view it as freeing up more brains to do the job we have. I know that it is going to be frustrating. But the key to it is that those in management cannot view other people without looking at their true value. You send signals not by what you say but by how you act.

You have the best people in the world and it is essential you be treated that way. If you are not being treated right, don't put up with it.

My next to last point is, we've got to remove the anger and fear and be so proud of what we are doing, and we've got to work together. You have the right leader, you have the right facilities, you are in the right place. It's crucial.

And finally, I am going to ask each of you to make a contract with your boss. On one sheet of paper, write down how you relate to what you are doing.

I went into the Optical Communications Lab yesterday and talked to a brilliant young man, and I was trying to understand what we would get back in terms of watts invested in terms of kilobits per watt, and how this related to the crossover point between communications and optical communications. It is not his fault, but the management in the research area didn't help him understand what the challenge was, and how optical commu-

nications fits into the picture.

You could work on the most wonderful technology with passion, but if you don't know how it relates to the big picture, are you working on the right thing?

You need to have this contract with your boss [stating] the inputs to you, the outputs, how do you relate and what are the things that you are going to accomplish during the year. Make it very clear. When you have fuzzy contracts, there is room for frustration, anger, and fear, and I hope I am not directing you, Ed; this is a request. You might want to think about it.

I went a long time, but I had a lot to say, and I don't have a chance to talk to you all the time, but I would like to close by saying I am deeply committed to the space program.

On July 20, 1969, when Apollo landed, I was at the airport. I was going to Harvard to take a course that summer and I missed my plane because I couldn't leave the TV set. Then when Neil Armstrong landed and stepped on the moon, I cried and hugged people I didn't even know. I would like to think that 10 or 15 years from now I could see a base on an asteroid and know that I had part of it and shared it with you. Thank you very much.

I am not going to take questions, but when we come around I'll be meeting with a cross section of people. I would be very happy to talk about these issues. I clearly feel passionately about them, but I don't have infinite wisdom.

The wisdom is in this room and at this Laboratory. But I hope that you have some understanding of the environment we are all working in, and that it is essential to work together. ❑